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Natural Salvation

The Message of Science

OUTLINING THE FIRST PRINCIPLES OF IMMORTAL
LIFE ON THE EARTH

BY

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DEDICATION.

Natural Salvation is addressed to all earnest students of Life and dedicated to that greater new era of Humanity which Science ushers in.

PREFATORY NOTE.

The researches made at this laboratory and its publications embrace,

LIVING MATTER; *Its Cycle of Growth and Decline in Animal Organisms.* 1888.

PLURICELLULAR MAN; *Whence and What is the Soul?* 1892.

LONG LIFE; *An Investigation of the Intimate Causes of Old-Aging and Organic Death, with a View to their Alleviation and Removal.* 1896.

NATURAL SALVATION; *The Message of Science; Outlining the First Principles of Immortal Life on the Earth.* 1903.

NATURAL SALVATION.

THE MESSAGE OF SCIENCE.

IT is a part of the unwritten code of science that the investigator shall avoid *a priori* conclusions, look coldly upon theory, and be wary of hypothesis. In a word, that he shall devote himself patiently to the acquisition of data, be content to collect facts, and live abstinent of the ever-present human weakness to play the rôle of prophet.

Nothing, indeed, so surely distinguishes the man of science from the charlatan as his attitude toward theory and his caution in presenting conclusions. A single page, often a single paragraph, of the article, or the book of a writer on scientific subjects, enables us to judge all too accurately of the value, or lack of value, of his entire effort; and, generally speaking, the verdict turns on the care with which he draws conclusions from data.

Science has endured so much of premature vaticination that its best friends and exponents have come to regard all that sort of thing with marked hostility, as detrimental to true progress. There is a disposition to put injudicious

enthusiasts outside the pale. A certain regimen has come to prevail; immature publication is held to be bad form as well as futile. Humility and an educated conservatism characterize the truly scientific mind: the attitude of Newton at the end of his grand discoveries.

With all that biology has of late demonstrated, we know too little still to say much of ultimate things. The time has not yet come when the creed of science can be written in full for general acceptance and signature.

It is in the nature and constitution of the human mind, however, to believe something. The history of mankind shows that those tribes, nations, and races which have gone forward with the greatest energy, have been actuated and incited by confident beliefs as to the origin and destiny of human beings.

In like manner the scientist has often found hypothesis an adjuvant; for an hypothesis is of the nature of a belief. Some of the most signal discoveries in astronomy, chemistry and biology have been elicited under guidance of provisional theories. There is a use as well as abuse of hypothesis; and, moreover, the theories of science are often *bona fide* glimpses of truth.

So at present, when the old faiths are fading out, like ghosts at dawn, when venerable "soul doctrines" are falling into desuetude and discredit, glimpses of the truth come and will serve to light us forward in the great outer darkness of the universe.

As such and such only are the present outlines of a greater gospel put forward: a provisional belief to be used as a scientist uses an hypothesis; probably true, better certainly than the existent babel of doctrines.

As regards Christianity, biological science now goes far to substantiate and confirm the original scheme of life and salvation, as conceived and taught by the Founder, but will purge it and separate it from those adventitious doctrines which Church Fathers, Bishops and Synods engrafted upon the new religion during the first three centuries of its existence. These doctrines were never essentially Christian, nor even Jewish, but of the nature of ingrowths from Persian, Greek, and Egyptian systems of philosophy.

Christianity, however, can hardly be said to be more than one of the religious beliefs of America. Allah, Brahma, Joss, and Mormon, as well as the Hebrew Jehovah, are now worshiped among us. Asia and Africa, as well as Europe, have contributed to the amazing *mélange* of tenets which stand for religion in the United States. Never in the world's history has such diversity of belief been exhibited in one country; yet each of these hundred and ten different cults is endeared to thousands of immigrant devotees by ancestral ties and traditions.

If by some megaphonic device we were able to hear, at one time and in one place, the amazing outcry of doctrines which goes up in thousands of churches, temples,

and other places of religious worship, the confusion would out-jargon that on the Plain of Shinar.

Such multiples of contradictory doctrines mutually discredit each other. It has followed naturally that the younger generation, born in America and educated in the public schools where general scientific knowledge is imparted, is quite without a faith, in the old-time meaning of that word, and looks to science for its real tenets.

Nor looks in vain. Even now, already, science is able to outline a new and greater faith ; and no prophetic gift is required to assure us that this new faith will be the religion of future America.

For a new hope has come to the human heart, the hope of salvation from “sin” and death by natural means : *Natural salvation*, contra-distinguished from supernatural salvation. Supernaturalism has been the burden of all previous religious systems. In all the past, human hopes have founded on rite, sacrifice, and supernatural rescue. But the keynote and initiative of the message of science is natural salvation : salvation under nature, accomplished by the growth and conservation of human knowledge.

In all the past man has turned to the skies and prayed to powers beyond the earth for salvation ; but now, at the dawn of the twentieth century, he turns to himself and gravely, hopefully estimates the problem of self-salvation.

Moreover, self-salvation, when regarded in the light of our present greater knowledge, is seen not to be new at

all, but to have been in progress ever since life first found foothold on the earth's surface! Apparently it has been in the natural order of things from the beginning.

We shall be able to show that natural salvation has been the tendency and trend of the evolution of life on the earth; that from the Silurian ages upward, life has put forth and developed toward a naturally attained freedom from evil conditions, "sin" and death; and moreover that the prospect for this is good. There is so much doubt, disheartenment and pessimism in the world that a plain statement of the human situation from the biological point of view cannot be otherwise than morally healthy. The progress of this great life movement on the surface of the globe constitutes a drama of surpassing interest, the grandest spectacle in nature.

As to the origin of life on the earth, we have no certain knowledge as yet, whether it came here from some other world in space, or originated here from a capacity to live inherent in matter. The former supposition puts the question of origin one step farther away; the latter is the one to which all intermediary theories must ultimately lead; for life is the subjective side of matter, its personal attribute: that property which renders the "ion" a "psychon."

It is not difficult to believe that there are other planetary globes where life develops more easily and with less travail and duress than on our earth. It is not incredible

that the first cell, spore, or perhaps still more rudimentary germ of life, arrived here from some other world. It has been held that the "molecule of protoplasm," so called, could not have originated on the earth. Cell life does not now come into existence spontaneously; and the inference is easy that the first unicellular life of the globe was from an implantation.

This conjecture once admitted, the next surmise might be that the earth was life-seeded by design, or from personal motives, on the part of intelligent beings inhabiting a more life-fertile globe in space. And it is more reassuring to think that such vital implantation was from beneficent design and to conceive of it as Divine. It is a moral contradiction that beings more intelligent than man should be malevolent. On this earth, at least, intellectual development does not tend to, or eventuate in, malevolence and cruelty, but rather in a desire to give happiness. By human standards, an omniscient mind could not be a "Satan"; yet we do not know what exists afar. To the normal mind there is not much in the present life struggle on the earth that indicates mercy, kindness, or beneficence.

There is no biological evidence, pro or con. The attitude of the universe toward life on the earth seems to be impersonal and neutral. Animal and vegetable life grows, bears seed and dies, unwatered, uncherished, unharvested. And while at first, owing to long indoctrination, this thought of uncherished neglect pains many

minds, it must on reflection come to be regarded as a glorious heritage of liberty — the liberty of the universe.

As nearly as can be estimated there is on the surface of the earth, at present, "protoplasm" (meaning matter temporarily in that condition of reciprocal activity which we term "living matter") to the amount of 5,500,460,500,000 tons.

Temporarily in the living condition, we say. For a significant almost startling phase of it is, that this vast quantity of matter is constantly passing out of the living into the non-living condition. As often as once in six hours, probably, once in twelve certainly on an average, the entire five or six trillions of tons of protoplasmic matter falls out of the living into the non-living condition; and *pari passu* an equally vast weight of non-living matter is raised up to the living condition. It is believed that all, or the most part, of the matter which makes up the outer strata of the earth to the depth of many miles, has at some time or other been in the living state, and not once or twice only, but many times.

We may, indeed, go much farther and not exceed what is probable in supposing that in the great past history of the universe — a history of successive series of solar and planetary formations — matter has lived in an infinite number of forms and types of life from eternity, intermittently and alternately.

For here it is significant to note the reversion of scientific opinion from the extremes of the dynamic hypothesis of *pure* force, toward the Newtonian idea. Light and also heat and electricity are not only dynamic, but material. Force, so far as we know it, is always associated with an efflux of matter.

The method by which this continuous passage of non-living into living matter is effected, is association and contact with previously existing living matter. The non-living must be infused into the living matter ere the non-living can be re-vitalized.

The intimate impulse which accomplishes this vast transfiguration seems to be a *subjective* one, resident in the "protoplasm" itself, or, in other words, in the matter which is, for the passing hour, in the living condition, and which sinks down from that living condition, while in the act of raising up non-living matter to its own level. The impulse, or working energy, is apparently a transgression of subjective sentience into matter-moving power or motion, effected at a great depth of atomicity, on that low plane where particles are able to move in response to a primarily sentient property which they universally possess.

It is from this low plane, or condition of tenuity, that "protoplasm" is built up, and sets forth in its wonderful career. On the earth as we now inhabit it, life struggles upward from this deep-lying, sentient plane of matter in

the teeth of a gigantic resistance. The energy in protoplasm is largely expended in overcoming this molar resistance; the bulk of our living substance has necessarily been impressed into mechanical service, — bone, teeth, hair, cuticle, muscle, tendon, in order to make way and obtain food. This, in fact, is life on earth, as man has thus far led it; but it is possible to improve the earth as a theater of life, and by the control and regulation of its "natural forces" to lessen the resistance.

Growth is a law of living matter; and on the earth's surface protoplasm is capable, under ordinarily favorable circumstances, of increasing its bulk much more rapidly than it wastes, or dies.

It is able to conserve energy. A cell is capable of raising up a greater amount of non-living matter into the living condition than it loses from the living condition by the act of so doing.

The only limit to such growth is the capacity of the earth as a field for life; it constantly sustains as much matter in the living condition as it has room for. The various genera and species of living things, moreover, mutually limit and restrict each other. But for animals, plants would probably overrun the earth to the full extent of its standing room; but for some species of animals, others would increase inordinately. Bacteria, in a favorable medium, propagate at a rate of which no conception can be given in figures.

The point of interest concerning this is that, given favorable conditions, with no checks to its growth, the tiniest dot of protoplasm might convert all the available matter of the universe into protoplasm! or, in other words, when once a *modicum* of matter, ever so small, has entered the living condition, it has the power to draw an infinite quantity of contiguous matter into the same life-expressing combination, and continue the process indefinitely. It is as if the universe of matter were combustible and the dot of protoplasm, introduced into it, were a spark of fire, — with this important difference, however, that growth of living matter implies the raising up of matter to higher degrees of complexity, or the storing up of potential energy in matter, the reverse of igneous combustion. While we cannot affirm that growth of protoplasm is creative of energy, it is certainly conservative of energy in a manner elsewhere and otherwise unknown.

In protoplasm, a higher or more primary attribute of matter, to wit, *sentience*, appears to make heat, light, and kindred modes of energy its servants and to successfully stem the ordinary effects of katabolism.

In past ages of the world, noticeably the carboniferous, a far greater quantity of matter has been in the living condition at one and the same time than at present; the indications are that there have been periods when the continents sustained twenty times more vegetable proto-

plasm, year by year, than during the present era. From age to age the quantity has varied in accord with the terrestrial conditions.

As yet we know no method of transmuting non-living into living matter apart from the agency of previously existent living matter. But no more can we at present make feldspar, or mica, or gold, or silver, or lead. It is as likely that we shall discover a method of producing living matter, as that we shall learn to produce any of these substances. The task waits a deeper knowledge of matter, but is impossible only for the present.

One reason for believing that new protoplasm and new protozoa no longer come into existence spontaneously, is that many or all of the micro-organisms which we study under the microscope are new only in the sense of being newly discovered by us. Many of the disease-bacteria were at least operative and produced the same poisons three thousand years ago. The diatomaceæ of to-day exhibit the same characteristics and the same silicious envelope as those taken from fossiliferous strata laid down in the seas of the tertiary epoch. In fact, many of the genera of micro-organisms are the most venerable and changeless of any upon the earth. Nor can we wholly agree with those who regard these minute creatures as the most rudimentary of living forms. It by no means follows that because a living creature is small, that it is hence exceedingly simple and recent in the sense of ancestry and heredity.

Another feature of this vast body of terrestrial living matter, the most remarkable, characteristic, and important feature indeed, is the singular mode in which it exists or lives, from moment to moment. Although of such vast bulk and weight when considered in the aggregate, it is never found in continuous bulk, but always exists as minute *modica*, or little measures, isolated one from another, scattered throughout and embedded in non-living matter. On an average, these minute *modica* of living matter or protoplasm are not much more than the three-thousandth of an inch in diameter, but occasionally reach the one two-hundredth and larger ; and their true or typical form is manifestly spherical. From the center of these small spherules life is exhibited. In consistency, the living substance is semi-fluid ; it is so nearly transparent as to be deemed colorless ; and it does not give off odorous particles. As above remarked, it is ordinary matter, oxygen, hydrogen, nitrogen, carbon, etc., and the cause of its peculiar behavior, in the living condition, is in all probability the manner in which the particles are combined, and their arrangement and relations one with another.

More profoundly, when we seek to know why living matter always assumes the form of and exists always in the small spherical integers, termed “cells,” we are brought to contemplate a new law of matter which apparently acts counter to gravitation, or, as is more likely, prevails upon an interior plane of matter within that on

which gravitation acts. It is the sway and prevalence of gravitation over ordinary matter which causes the world of matter, as we see it, to appear lifeless and inert. But in protoplasm, pure and unalloyed, we behold a law of matter, find expression, subversive of gravity, prevalent over it and transfiguring ordinary matter to living matter in spite of gravity, so to speak. This may seem a bold statement. Life, indeed, has been held by many biologists to be a corelate of gravitation, a cognate and derivative mode of the universal energy of matter. Cognate, indeed, it no doubt is ; derivative also in the loose sense of being aided and facilitated by it in all the larger forms of terrestrial life ; for it is assuredly not the intention here to convey the idea that the ordinary functions of animals are carried on contrary to gravity or chemism. The writer ventures, however, to set forth the conception that within a normal "cell" of living matter there is an expression of energy not derived from gravitation, but superior to it ; as if emanating from an inner seat of energy, as if acting upon matter at a different angle or *point d'appui*. Such an opinion by no means conflicts with the monistic conception of energy. It is meant merely to set forth that life is not the immediate derivative of gravitation, or chemism, which many physical philosophers have been inclined to consider it, but rather a static property of matter which antedates gravity, and, in the intimate composition of matter, outranks it.

Indeed, the truer view of this great question is probably that life finds but an irregular, erratic expression in the superficies of the terrestrial globe, where gravity and the grosser modes of universal energy prevail as a rule. Yet the conception will be found to grow in the mind of the student of living matter, that this wonderful static property is a very universal property; in a word, that all matter is *sentient* at bottom; and that its apparent *insentience*, or lifelessness and inertia, as seen on the earth, is less a natural than an unnatural and fortuitous condition into which it has fallen from the peculiar recoils incident to planetary formation.

This view need not incline the student to entertain pantheistic conceptions of matter, or drift away to extreme opinions as to a universal mind inherent in nature: an ocean of omniscient intellect, from which our "souls" are stray driplets. On the contrary, the entire trend and drift of biological science are to the effect that the primary static property of matter is sentience only in the sense that the raw flax is damask, that the crude ore is a steel warship, and that in the great tracts of universal matter there is nothing more intelligent than the *elements of intelligence*; even as in "protoplasm" of lowly grade there is little save the capacity to feel. Be it remembered, too, that there is now, probably, no "protoplasm" existent on the earth's surface of such lowly grade, such archaic simplicity upon the scale of intelligence, as

that which first stirred on the early shores of the azoic oceans.

As the student examines those wonderful little integers, the "cells," day by day, the inquiry constantly presents itself, Why does the living matter adopt this form? Why does it live in these little globules of uniform size? — for although the size of cells differs considerably relatively to each other in different tissues and situations, the difference is mainly within certain definite limits; and the general type and form are unmistakable and apparently unchangeable.

Why does protoplasm exist in such small measures of substance, each scarcely more than a pin's point? Why do its "cells" fail, since they are constantly growing, to attain larger size, an inch or more in diameter? Why do they not coalesce in the tissues into one sentient working mass? And why, on the contrary, do they constantly divide, when these small dimensions are reached, and become dormant, die even, rather than transgress them? These are inquiries which the student will find often recurring as he observes cell life. The idea conveyed from the totality of such questionings is one of a certain ever-present barrier to protoplasmic life, or a constantly restricting law which makes life on the earth possible only in this small form, or type. Some stress of terrestrial matter appears to confine life to this minute expression. This little cell is the only way in which life upwells

from the profound depths of matter. For it is apparent that the cell is but the *form*, the tiny thread-like channel from a deep-lying stratum, through which some very esoteric or final property of matter flickers up.

So great confusion of thought has often been exhibited on this subject of cell consentience that it is important to set the matter in a clear light. In the cell-of-life we have presented the spectacle of a thousandth of a grain of matter—oxygen, hydrogen, nitrogen, sulphur, phosphorus—which has set itself to *live*, set up for itself as against the rest of the universe, stepped out from its former relationship and allegiance to other matter, and started a new little world of its own. For that is what a living cell really is: a minute portion of universal matter which has withdrawn from the rest and set up autonomy. The laws of matter no longer control this thousandth of a grain of matter as formerly.

In every animal and in every cell there is always matter, a large per cent. of its bulk, which is not living, and hence inert; but the really living portion of the cell carries itself in defiance of gravitation. True, it is borne on by the earth on its orbit and revolves with it; none the less it is able to direct chemical action for its own behoof and combine forces to overcome gravity when it wishes to climb hills or trees. In a word, it fights gravitation to do as it pleases, and succeeds. So long as it lives and is not crushed out, it is to a degree independent and self-directive.

The present development of life on the earth began in the age which geologists term the Silurian; but the presence of graphite in the Laurentian, or "azoic" rocks renders it not incredible that there was a previous life development which terminated, or was followed by a period of high temperature.

But to return to what is known, keeping it separate from conjecture, we find that low forms of unicellular life were existing on the earth many millions of years ago. Geology affords the evidence of this, though the exact number of millions of years is still debatable. That is not material to our purpose, however; it was a very long time ago. Fire, water, and unicellular life have wrought together to make the earth's surface what we find it to-day. But geologists are agreed that there was an azoic, or lifeless age, followed by an epoch when protozoons — vegetable and animal cells of life, the monera, protamœbidæ, diatoms, algæ, myxopods, rhizopods, ciliata, flagellata, *et al.* — had appeared; unicellular creatures from one ten-thousandth to a hundredth of an inch in diameter.

For millions, perhaps hundreds of millions of years, certain of these protozoons were the sole inhabitants of the earth which was fit for no higher form of life; or, if fit, no higher form had developed. Nothing more graphically illustrates the wealth of time at Nature's disposal, or the fact that the course of nature cannot be judged by human

standards. Metazoons, creatures of higher, more complex organization, were to appear on the earth ; yet through all these millions of years no sign or semblance of them was visible. Were three million centuries of unicellular life necessary to prepare the earth's surface for metazoons ? The question is idle. Every measure of our estimation of nature breaks down on extended application. We have no code of morals for nature and can have none, for nature is eternal, and man a being of yesterdays and to-morrows.

The point to make here pertains merely to the fact that for ages and epochs, to which all subsequent time is but as an hour to a day, a lowly unicellular life was all that the earth bore.

Observers from afar, if such there were, might well have concluded that there would be no further development ; thus other planets appear to our terrestrial astronomers ; the epoch of life, or of the higher life-forms, has not yet arrived, or has passed.

Then occurred a new departure in terrestrial life, an innovation, but when, how early, or how late in that first long epoch of unicellular life we do not know. Some time during those millions of the earth's unhistoric revolutions an innovation on unicellular life began. From accident of the environment, or, perchance, from

malformation, two or more cells began to live united together, and to act in unison — the earliest metazoon! Or, as some biologists conjecture, an unusually tough cell wall, or membrane, may have restricted the ordinary course of multiplication by fission. The offspring or increase of a certain protozoon may have been unable to separate from the parent cell, to lead an individual life apart, as formerly, and thus two or more protozoa may have come to live together, in sentient, protoplasmic contact as one life, and to act for a common interest.

It is not essential to our argument to show how metazoons began. The point made is, that they came into existence and, beyond doubt, originated from the unicellular life which antedated them. In some way two or more cells contrived to merge their hitherto separate lives in one. Their separate sentiences were pooled, so to speak, in one consentient life.

This was accomplished by means of close protoplasmic contact, when the two hitherto separate cell lives coalesced, like two drops of water on a window-pane. For it is possible for two cells to live as one and form a single life or self-conscious existence, if there is close protoplasmic connection between the two, that is to say, if they touch each other, or are joined together by one or more threads of the sentient living matter. When this occurs, the two cells may have one common life, or soul, in place of the two lives previous to the union. One common life may

take the place of two; and yet the two cell substances do not become confluent or coalesce; they merely touch and remain separate seats, or fountains of sentience; it is the two sentiences only which unite; as when two springs which issue at points near together combine their waters in one rill. The two cell lives combine in one stream, but the cells themselves remain distinct, separate founts of life. The tremendous significance of this fact is little recognized or understood as yet. It subverts the present theological doctrine of the human soul. It demonstrates that the intellect of man, the human personality, is composite and dissoluble.

At the outset, however, certain hasty conclusions which have sometimes misled investigators should be avoided. The bodies of the higher animals are something more than confederations of unicellular life; that is to say, they have not come directly from a banding together of cells that once lived separately. The animal organism develops from a single cell in the egg. All the millions of cells in the various tissues issue forth, seriatim, from this one reproductive cell, which seems to contain representative particles, reproductive molecules, or "biophors," and "determinants," corresponding to every tissue cell of the parent organism. We have by no means sounded the depths of this latter problem, as yet. One conjecture is, that the entire animal organism, in corelation with its generative tissue, fructifies in a species of sub-unicellular

life; a germ life as far below the tissue cell life in size and bulk as the cell is smaller than the whole animal organism. The cell would thus appear to extrude a species of minute offspring which are assembled, as a colony, in the ovum.

Animals are grand communities of cells and something more, the result of long organization and new methods of cell life. But this distinction does not essentially detract from the importance which attaches to the phenomenon disclosed to us when *two cells combine to live one life*. I have termed this a new departure, yet must not be understood to assert that it took place suddenly, as being the beginning or end of an epoch, or as indicating a "creative act," that mental lapse to which certain venerable savants are so prone.

Here, too, it will be well to enlarge the common conception of a "cell." We are apt to think of unicellular life as being very low and simple, far down toward the primary molecules and "atoms" of matter. Whereas the truth appears to be that the "cell" is a relatively huge and vastly complex organism; and that the unicellular life of the globe is an evolution of a most hoary antiquity; herewith also this other fact should be associated and kept in mind, namely, that in the bodies of metazoons, in plants and trees, the unicellular type of life, this ancient life of the Silurian ages, still persists. In fact, it will hardly be too much to say that the unicellular is the

only real, distinct type of life which exists, or has ever existed on the earth's surface. Since all the metazoons are but more or less well-organized and well-perfected confraternities of cell life, where the individual lives of millions of cells are unified in a single, larger personality.

Many of the polyzoa are suggestive of the manner in which multicellular organisms started. In *paludicella* we find cells joined together, as joints or sections of the branches of a minute tree-like growth, attached to stones in streams. It is a tree in miniature; the cells grow forth, one beyond another, offspring above parent cell, but otherwise have little connection one with another. It is simply an arboriform colony, or *zoarium*. Other polyzoa, like *mucronella*, form mat-like disks on stones in water, the cells lying in contact merely.

In certain of the zoaria of polyzoa, however, a considerable degree of individualization is exhibited with division of labor among the cells. In *christatella mucedo* the cells not only adhere, but the whole colony crawls with considerable facility from one water weed to another. *Kinetoskias* is another zoarium where the colony has arrived at the point of differentiation of function. *Adeona* presents an equally interesting example of a simple colony of unicells on its way toward a many-celled organism.

Among the hydrozoa, *siphonophora* affords an example where a floating colony of unicells has taken definite form and organized its individual cells to work for the common

good. In siphonophora, as, indeed, in hundreds of other instances, the beginnings of multicellular mind are apparent. That is to say, there is present not only the cell intelligence — that which pertains to all cells — but that larger intelligence which comes into existence from the consentience of the entire colony — the pooling of the separate cell sentiences in one larger intelligence.

This habit among protozoons of colonizing — however it originated — opened the way to metazoons. Often the colony grows up around one mother cell, whose offspring instead of dispersing remain loosely attached together. Of such agglomerations *anthophysa vegetans* is a good instance.

In other instances the envelope, or cuticle, of the mother cell expands and enlarges, forming a sac which contains the entire colony for a considerable time, till the reproductive power of the parent cell is exhausted. Eventually the sac bursts and the group disperses. Many of the flagellates exhibit this phenomenon, the parent organism continuing to move about after becoming a colony instead of a single cell.

In *gonium pectorale*, a volvocine of stagnant fresh waters, a colony of sixteen offspring cells adhere laterally to each other, in the form of a minute, rectangular plaque of a light green color. *Pandorina*, on the other hand, gives birth to either sixteen or thirty-two offspring, which live for a time in a species of globular colony, inside a thin

envelope, through which each cell thrusts out two flagella. While living as a colony, these sixteen or thirty-two cells act together, as if actuated by a common impulse, moving their flagella in unison to propel the colony. It changes direction, tacks suddenly, and otherwise affords evidence that all the cells are acting together as one. Either there is a sentient contact which serves to enable the sixteen separate cells to act as one, or else a temporary species of nervous system, consisting of filamentous processes thrust forth from cell to cell.

In the oft-cited instance of *volvox globator*, the colony is of more complicated structure and forms a large green ball, to the surface of which the individual cells adhere in great numbers, as many as twelve thousands to a ball having been counted. In this case they appear to touch each other and are each provided with two flagella which project through the membrane. Here each cell appears to be a free agent within its own envelope, but projects protoplasmic threads or filaments, like telephonic wires, into its neighbors, by means of which a network of consentient communication is established. At an internal signal all the thousands of flagella swing in harmony like oars, and the ball moves from point to point. It is clear that something analogous to a nervous system is here present, even though of an ephemeral nature, consisting of filaments which can be thrust out and withdrawn at will.

In the diœcian *volvox* the male colony remains apart

from the female cellules, except at time of fecundation, when both colonies break up, scatter, and presently conjugate in pairs and groups.

Colonies of protozoons which come from a single parent cell present some analogy with a multicellular animal organism, which also develops from a single egg-cell. The way, however, from a colony of *protista* to the organism of a vertebrate animal is long and, in its ætiology, but little understood.

The first metazoons were clearly temporary makeshifts, owing to stress of accidental conditions. It is likely, indeed, that they had often occurred for millions of years, occurred thousands of times, but had died out, or progressed no further than the polyzoa we see at present time, owing to unvarying conditions, flood and drought, heat and cold. But at some time one or more of these unions of cells chanced to survive longer and took more permanent form, sufficient permanence to carry it on and set up a new mode of life by organization — that organization and differentiation of cell function which was to play so grand a part in the future.

Space and a desire to make the argument continuous prevent more extended enumeration of such primitive unions of unicellular life. But one has only to look abroad on the face of nature to see conclusive proof of the position here taken. In every tree, shrub, and plant, in every animal that walks, every bird and insect that flies, we

behold an agglomerated organized mass, or congeries, of cells, each filling its place and doing its appropriate part in a cell commonwealth. There may be thousands of cells in the plant or insect, or there may be millions in the tree or the animal. The proof, we say, is on all sides. Tree, animal, insect, alike, are examples of this principle of *e pluribus unum*, for the common good of all.

We wish here merely to show the manner in which the metazoons started, and the significance of the act when two or more protozoons unite to live one life and become one larger self.

No claim is set up here, that we know at present, from what colonies or unions of primitive unicells the vertebrata were developed. Nature, indeed, appears to have performed many strange experiments in multicellular organisms, long-extended and horrible experiments, which go far to convince us that we must not deify or even personify nature. For nature is elemental and impersonal. The unicells first organized in uncouth and savage forms,

“Dragons of the prime that tare each other in their slime.”

Dinosaur, megatherium, and mastodon roared and battled through ages that to man are incomprehensible.

“A monstrous eft was at one time lord and master of earth,
For him the bright sun shone and his river billowing ran.”

Man's hundred thousand years are but as a span to the era of vertebrate monsters and monstrosities, while earth's young unicells were making their first tremendous efforts at organization.

But when two or more cells unite to live together as one, each has first to surrender, either temporarily or permanently, its own self-conscious personality ; and then as a merger of all these surrendered personalities there ensues a larger, grander self about a new axis of self-consciousness.

The most perfect example of this self-surrender and resultant, grand consentience is exhibited in the brain of man. Here temporarily during the day some sixty millions of "cells" extend filamentous processes and, all taking hold of hands, so to speak, surrender each its self-consciousness and autonomy to form the human intellect. From this grand surrender, and at the instant it is made, there flashes forth the consentient human personality, the "soul of man." It is done as if by electric contact. This intellect or "soul" is the union of these sixty millions of brain cell lives ; they surrender self to live as one.

But in the brain this is but a temporary self-surrender. Owing probably to the severe vital draught which the consentience makes on the individual cell the human intellect cannot remain constant or continuous. There

must be respite and recuperation for the constituent cells. Accordingly we find that after ten or fifteen hours the consentient strain is relieved; the union is disrupted. Sleep ensues. Suddenly, as suddenly as it began, the brain cells let go hands. The filaments are retracted. Contact is broken. Each cell resumes its individual life, becomes itself again, self-conscious, and attends to its own personal affairs — nutrition, elimination of waste products, rest, growth.

But the instant the cells resume self-life, the human intellect has ceased, as when electric contact is broken, unconsciousness supervenes.

Why, it may be asked, why and how did the first two or more protozoons come to unite their self-lives in one larger self? From what seems accident of the environment, on the *objective* side; and for greater comfort, ease, and safety, on the *subjective* side; or rather when accident, or "the law of chance," had initiated the innovation, the subjective comfort which resulted from it led to a voluntary and wilful continuance of the new mode of living.

For by thus uniting, a division of the hard labor of living was possible; the single cell was no longer compelled to face the world alone and perform all the various kinds of labor which the act of living necessitated. After combining, one cell could do one kind of work and confine itself to that, and another, another kind. One cell, or group of cells, could attend to locomotion, as in *volvox*,

another to securing food, and still another to digestion and assimilation of the food.

Soon, indeed, one cell, or group of cells, in the union, took upon itself the office of spying out food, or sighting danger and notifying the motive group to move forward swiftly, or to beat a hasty retreat. This spy cell, or group of cells, soon assumed the leadership. In time, complete differentiation of labor-function was effected. The locomotive or muscle group not only performed no other kind of labor, but became unable to perform other. Its internal organization conformed to this want of the union. So of the group which seized, or digested food, and preeminently so of the spy cell group which ere long devoted itself exclusively to discernment, intelligent decisions and a general directorate and protectorate of the other groups.

This apparent development of metazoons from protozoons, of so great significance in the terrestrial scheme of life, was set forth by this author some years since a little more in detail. •

“Very soon after creatures composed of many cells (metazoons) were developed from groups of unicellular life, the necessities of locomotion in the struggle for food led to the differentiation of certain tracts of cells as bone and muscle, and finally to the development of the entire apparatus for mechanical movements.

“Simultaneously, too, another peculiar species of differentiation began to be necessary, namely, a special tis-

sue, whose office should be that of intercommunication between the different associated cells and tracts of cells which were thus assuming more and more diverse offices, and becoming somewhat different in character, one from another. It was thus and for this reason that a nervous system began to be needed and hence to develop; for the plastic, living substance has always shown a faculty of adapting itself to widely variant functions and modes of living.

“ Certain cells began to take up the business of receiving sensory influences from outlying cells which were hard pressed or in want of food, and of transmitting such sensory influences to contiguous cells. In short, certain lines of internal cells began to take upon themselves the task of conveying the sensations of others from one tract of the cellular mass to another tract, and of interpreting the sensation received from one tract to the comprehension of the sentience of another tract, so that action, within its sphere of action, would ensue in the second tract. In addition to their own sentient economy, these lines of cells in the incipient nervous system took up the function of common carriers of *sense*, and also the office of interpreters of the sensory language of one order of cells — if I may borrow the figure — to the different language of another order.

“ Thus, humbly, as we conclude from observation of low forms of life, did the nervous system, or tissue of in-

telligence, begin to develop. Primarily there was but one or two simple thread-like lines of cells attempting the office of transmitting feeling, and succeeding indifferently at first; but as animals increased in size, the business of telegraphing sensation grew, and a net-work of lines was developed. Sensation was going both ways, and soon the necessity of a common center to which sensory influences could be brought, and thence distributed to their proper destination, was forced upon the nascent, sense-conveying cells, and a ganglion, or little brain, came into existence. The confusion, too, resulting from counter-currents of feeling soon led to the formation of double lines, one for transmitting sensation inward, the other for transmission outward; and thus the divisions of sensory and motor nerves were inaugurated to and from the little brain center, which presently assumed the function of deciding upon the merits of transmitted sensations, and responding to them by a message from its own sensibility.

“Nerve ganglia multiplied as animals increased in bulk and attempted larger movements; and in time, to avoid confusion and get the organic business done, one ganglion was obliged to take the lead and keep order among the other ganglia, to decide between them when they got at variance, and generally to take the office of head ganglion.

“Thus, in time, a larger and capitally important ganglion was raised up into prominence to perform the function of oyer and terminer, a cerebellum, and finally a

cerebrum, — a mass of highly organized cells which have from long use and inherited development the capacity for intelligent perception and thought."

Without any attempt to present a consecutive line of examples to illustrate the progressive development of the cerebro-spinal system, the above outline indicates the principle upon which this group of cells has come forward to occupy its present grand prominence as exponents of intelligence.

In treating of the cells of the brain as individual, living creatures, it may be well to set forth more explicitly what their *status* of intelligence probably is, and explain how far they may be regarded as sentient. It is not claimed for any unicellular creature that it possesses rational powers to such extent as is evinced by an organized tract of cells like that of the human brain. For in the human brain we find a great number of cells of four or more varieties, devoted some to memory, some to reason or the comparison of experiences, some to vision, some to hearing, and some to the estimation of the odors and flavors; and it is the sentience and experience of them all which is combined in the human intellect. Yet from observations of unicellular life we find, as in the case of ciliates, that it is quite possible for a single cell, no larger than many of the brain cells, to possess not only sentience, but to acquire the data of memory, and to act from its previous experience. Many forms of unicellular life, indeed, behave

rationally; nor is there reason to suppose that the cells of the brain are less capable of perception and of memory. In the brain, however, cells of different tracts are concerned with experiences of particular kinds, some recording the data of vision, others the data of hearing, and still others collating and comparing such data. It is probable that a cell of the tract or group in the area of vision, for example, is largely occupied with depiction of visual imagery, and becomes a kind of living, sentient specialist, or expert in colors and scenery.

None the less it is a sentient creature, with its own internal economy of nutrition and growth. In a word, it is a sentient self. It perceives, lives and acts from its own personal point of view, for its own behoof and welfare. This much is quite certain. It is a sentient creature and within its limited sphere has acquired a kind of wisdom of its own. More we cannot predicate of the individual cell. It is a pygmy of a limited degree of intelligence.

Nor does our argument claim that the protozoons first banded together from intelligent foresight as to the result of union. The beginnings of metazoic life were probably accidental *per se*. But the results of union and division of labor followed quite the same, and it is from these actual results that our conclusions are drawn. By union of their hitherto separate sentiences the cells evolved a higher kind of sentience, a *nous*, a soul, developed to a

higher degree of intelligence, from the exercise of which each cell of the organic union was grandly benefited in the matter of food and protection, and is enabled to become a participator and beneficiary of mind.

It may be added that the later physiology portrays the connection and intercommunication of cells in metazoons as based on and maintained by currents of "ions," liberated and set in motion by the vital processes, and depicts life itself as arising from the reciprocal action of these biogenetic units of matter.

The passage from the unicellular to organized multicellular forms of life, from protozoa to metazoa, was primarily effected by simple combinations of cells and varying of their functions. It was thus that the animal organism originated. The question of importance next to be asked is, What was gained by it? Of what use was it? What advantage accrued from it to the cells themselves which, from the strict biological point of view, are not only the first, but the only type of life that has ever appeared on the earth; since all life, organic as well as unicellular, goes on by virtue and instrumentality of the "cell" mode.

What advantage therefore has accrued to the cell, and how far has it by this means advanced toward that natural salvation which is the goal of all life?

A survey of the whole field shows clearly that the single cell made a great personal gain by uniting its life

with its fellows. This is apparent even in the primitive colony of ciliates, more evident still in volvox, and grandly demonstrated in the animal organism. The cell in the colony lived longer and more comfortably than when struggling for life, alone; and at the acme of organization, in the vertebrate organism, we find cells which have attained to what is, for a cell, immortality. In unorganized unicellular life, the average life-time of a cell may have been less than two days, not much longer. In organized metazoic life, we find the neurons of the cerebral cortex of an elephant, or a whale, for example, living two centuries. By combining with their fellows, these cells, or their descendants, have increased their span of life thirty thousand times!

In man these brain cells often survive for a century. Human beings, with life-times correspondingly prolonged, would live to the age of eighteen thousand years.

It is apparent, moreover, that these groups of brain cells would live longer (for they give little evidence of having exhausted their capacity for living on) but for the fact that they are dragged down to death by the fate of the organism, *i. e.*, the failure of coordination among the other tissue groups of cells.

This is profoundly interesting as showing what cell life, under favorable conditions, may accomplish in the way of a vast longevity, — from successful combinations, and organization generally. There appear to be cells of the

brain which would live on indefinitely were it not for accidents to other parts of the organism.

Generally speaking, longevity is the proof of correct living. That cell, or union of cells, lives long that is well nourished and well protected. No animal organism is as yet perfect, even approximately so. All the groups of tissue cells have not been equally advantaged by organic union, but taken together a great gain has resulted, chiefly in the matter of food and protection. The brain and muscle cells of the animal organism, for example, have their food specially prepared for them along the intestinal tract and brought to them in the arterial conduits, and they are housed and shielded from the mordant action of oxygen and the attacks of hostile bacteria by the integument and bony walls.

All the physiological cells are alike benefited in that prime requisite, food; and this fact must be kept in view when the higher social organization of the metazoons is considered. Food specially prepared and refined by groups of cells which have made this office their business, has largely conduced to the longevity of the physiological cell and made brain possible. Without a specially prepared food the organic cell could not survive for a day. Improved food, protection from enemies and, subjectively, that greater guiding intelligence that comes from organic life are the factors which have so improved the cell (the protozoon developed to a neuron) that it lives for a

century in man, and in the whale, the carp and the elephant for two centuries.

In plant life as we now view it, banding together has not been as advantageous for the saprophytic cell. We have trees two thousand years old; but so far as we at present understand the arboreal economy, the vegetable cellules are not long-lived. This would follow, *a priori*, from the far less perfect organization of plants, the more crude food supplied to the cells, imperfect protection and the apparently inferior sentience of the cells themselves. The contrast but emphasizes the deduction made for the physiological cell, namely, that it has attained its pre-eminence by perfecting the organic union of which it is a unit. And the inference has sometimes been drawn that could the metazoon as seen in the animal organism be given a more perfect development, the component cells would reach that acme of natural salvation for which they have striven for two millions of centuries and would become, in very truth, deathless cells-of-life.

There is no more wonderful and grandly instructive spectacle in nature than this widespread and long-extended effort of the globe's unicellular life to save and preserve itself from hardship, accident, "disease," and death. Nor has the effort been "instinctive" in any other sense than all sentience is instinctive. From the subjective side of life, the primitive unicells of the ancient earth began to live together for mutual comfort, aid, and pro-

tection, and continued these unions till by division of labor and differentiation of function the simple colony developed into the vertebrate animal organism, with its thirty specialized genera of cells, all acting together for the common weal.

Man must still turn to the unicells for grand examples of social organization and progress by means of organization. Vastly and grandly more than is yet exhibited in human civilizations have the protozoons united and combined for mutual betterment. In this maple, towering in leafy beauty, we may find two billions of arboreal cells, organized, apportioned for diverse labors, trained to special work, devoted and artisaned to the production of fiber, bark, sugar, and chlorophyl, and all in an orderly sequence of effects and a consecration of each cell self to its appointed task, and with an apparent content and faith in the outcome, when each does his share, such as the human world has never yet seen nor understood.

In that horse dashing along the track we behold several billions of cells, each a living creature, an individual life, banded, united, and organized in such multicellular complexity that it is the glory of anatomy and histology even to have demonstrated and described it. And in the matter of locomotion — since speed is the criterion in the horse — we may behold this entire body of cells moving at a speed a million times greater than that at which it would be possible for these cells to move if living isolated

and solitary, as did the ancestral protozoon on the beach of the Cambrian Ocean.

We should not here be understood as denying or leaving out of the account the influence which the metazoic mind exerts for longevity. It is by reason of this superior intelligence, obtained by banding the small wits of the cells together, that those better conditions were gained which make cell longevity possible. Nor yet would we appear to assert that the animal organism lives for the benefit, or at the behoof of the component cells. In the animal brain the cells live to themselves only during the eight or ten hours of sleep daily. During waking hours the lives of all these cells are consentient, having banded and blended together to form the self-conscious mind of the animal, which devotes its energies to supplying the animal wants. Without this consentient union for mentation, locomotion, and general muscular activity, the animal could not have developed. The component cells improved, each its individual condition, by forming a consentient partnership.

This point might readily be given fuller illustration, and a thousand examples of metazoic life cited in evidence of the principle, rationale, and intent of the passage from unicellular to multicellular life; but the idea has been conveyed; and this is enough for our present purpose. The genuineness of the deduction can hardly be controverted. By banding together and by organization, with division of

labor for the common good of the union, the cell-of-life, as first seen in the protozoon, has come to live two centuries, instead of two days, with a legitimate inference that it is practically deathless under improved organic conditions. That is to say, there is nothing in the constitution of the cell, no biogenetic law, that prevents it from living indefinitely. Revolutionary as this deduction may appear to those who teach and believe that death is a final law of nature, the reverse of that doctrine can now be confidently maintained. It need scarcely be added that this conclusion is of the greatest significance, as affecting our beliefs concerning human life and the future of life on the earth.

And now after metazoons, what? After cell unions and cell organization in the animal organism, what next? After an organized development which has resulted in the advancement of the cell, the brain cell, to a high degree of intelligence and a grand longevity, what next in the line of its progress?

Bearing in mind that the cell is the original and, strictly speaking, the only type or mode of life which has thus far appeared on the earth, what means will be adopted to still further improve and better its lot? Will it of its own initiative inaugurate anything better or greater than the animal organism as we see it about the cerebro-spinal axis in vertebrates?

The answer would seem to be no, as regards the individual cell, and yes, as regards the consentient union of cells as displayed in the brain and mind of animals and man. And if yes, what has already been accomplished in this larger corporate capacity? Union and organization are manifestly the order and method of all life on the earth. Since the cell banded in the metazoons and made a grand gain for itself in so doing, we might naturally look for unions of metazoons for mutual benefit and progress. But here, as against such actual unions by contact, the physical laws of the globe of matter on which we live interpose obstacles. We cannot have sixty millions of men, or monkeys, or elephants living in a ball, like *volvox*. Contact-union for mutual aid, defense, protection, comfort, and improved food is limited. If we attempted to unite or blend a nation of people as a metazon, or even make it resemble one in the matter of consentience, as, for example, the eighty or more millions in the United States, or the forty millions of Great Britain, every person, or citizen, would need to be represented as almost wholly deprived of locomotion, and seated, as if at a desk or table, in one place, where food and the material for his work were brought to him in ducts and tubes. Still further, it would be necessary to conceive of them all as built in and encased by the substances which they manufacture. Further still, and most essential of all to the truth and pertinence of the simile, we should need to depict every

citizen as connected with his neighbors and through them with every other citizen, by cables, bands, or cords of sentient living matter continuous with his own living substance. We must picture, too, the more prominent class of citizens as having thrust forth immensely long tentacles, forming nets of this same sentient matter, extending long distances from their bodies, and lying in close contact with similar tentacles belonging to hundreds of their fellows, in order that they may feel and literally *sense* all that they do or think.

If this condition of things existed throughout the nation, we should undoubtedly find the individual citizens living as one enormous National Person. In place of eighty millions of individual men and women, we should see them unified in a self-conscious national life. Such a nation would act and conduct itself among other nations as a Personal Being.

Upon a lower plane of inorganic relationship of particle to particle and ion to ion, in the atomic sense, it is possible that such a unified personality possesses the universe, answering to the indefinite conception of deity. Gravitation has been held to be the lowly organized personality of cosmos, expressing itself in natural phenomena. Von Hartmann, in his "Philosophy of the Unconscious," appears to have grasped some such conception, which, however, he immediately perverted to the exigencies of an immoral philosophy.

Since meta-metazoons, as of vertebrates, are physical impossibilities, the advantages which come from union and organization have to be secured in a different way, by other methods of obtaining the necessary consentience.

In hymenoptera (insect metazoons) the bees and ants offer suggestive examples of social and economic unions. In the swarm and apiary we find that differentiation of function and division of labor have proceeded far, and taken their place in heredity; and in the case of the queen bee the social organization has operated to greatly prolong her life. Swarm life also serves to afford general protection from enemies, equalize the food supply, and defend the union against the rigors of climate.

In the termite ants we find not only all these advantages gained from swarm organization, but others that come from the war-like operations which organized union renders possible.

In bird life, crows, pigeons, geese, penguins, and many other species have attained advantages from rude organization; and in mammalian life there are many humble examples of flocking, herding and banding together for mutual benefit, to gain protection from enemies and to secure food. The wild horse, bison and caribou herd for protection; wolves pack to pull down larger animals for food; baboons, monkeys and savage humans band, tribe and horde for protection, better food and companionship.

The lower vertebrate orders and primitive man have

thus set us examples, so to speak, pioneered the way and initiated that larger organization by virtue of which "civilization" has arisen. The early and wild mutations of men furnish complicated yet fairly clear studies of the development of the nation from the tribe and the clan. No different principle is involved than that seen to be operative in the flock and horde, and also in the ant-hill and hive. It is the "instinctive" sentient effort and push of the cell-of-life to obtain better conditions.

It is not the intention here to enter upon the political history of mankind, the rise of nations and empires, or the causes of their decline. Nor yet to trace the beginnings of commerce, or the rise of the arts and sciences; or recount the history of war and the constant world-wide struggle for freedom from oppression. It is all a part of that process of union and organization of humanity, to secure higher advantages. Something analogous to it has taken place among the tissue cells in the development of the animal organism: the natural clash of conflicting interests, the fight of self against self-surrender for the common good, that self-surrender which comes so hard, yet always redounds subsequently to the individual good and ennoblement.

For fifty thousand years the effort at human organization has ebbed and flowed, operating blindly, misled by a thousand false ideals and "revelations." Religion has fought against religion, cult against cult, and "god"

against "god." For the true law of human progress was not yet perceived. The ideal of human confraternity was not yet recognized ; that ideal which the convexed surface of the globe so strongly suggests, and which the greater history of cell life so convincingly teaches. For it is the inestimable privilege of our science to narrate the rise of the cell-of-life and demonstrate the method and law of its progress ; to found natural salvation and uphold a new ideal ; to confirm the doctrine of human brotherhood as taught by the Founder of the Christian religion and, incidentally, to show why that sublime doctrine has for nineteen centuries appealed so strongly to the human heart ; because it is a law of terrestrial life and a necessity to further human progress.

The advisability of peace and good-will among men had been taught before the Christian era, and the advantages of harmonious action set forth by others ; but the personage who appears in history as Joshua, or Jesus, was the first who profoundly *felt* and *lived* it, and gave his life for it. In his mind glowed that divine ideal of a "kingdom of God" arising from brotherly love and that mutual co-operation and union of all humanity which alone can insure salvation under nature. Biology endorses with a cordial reverence the tremendous efficacy of that ideal and shows it to be in line with the whole progress of life on the earth. Science now labors for the realization of that ideal. Every other doctrine of the Christian faith

will fall, its eschatology fade away. That alone will remain; for it is, indeed, millions of years old; it has been operative for two millions of centuries. Thousands of years before our era, unhistoric Christs had announced it in horde and conclave and died for it; but Jesus put it in the form of a world-faith for this latter epoch; and his service of love must ever command our reverent affection. He identified himself with that universal law of life by virtue of which ion and primeval psychon surrender their self-lives to form the cell life, the cell the human intellect, and by virtue of which still the human life will hereafter live in the grander life of a deathless humanity. For the psychon is not self-lost in the cell, nor the cell in the organism, but from its self-surrender lives a better and longer life; and in the future grand sodality of human life the individuals will become immortal, even as the cell has prolonged its life in the brain. The vital unit is not lost in the union. What it gives of self to the organization returns to it again with compensations; and he who casts his life into the consentient human effort, takes it again, ennobled by self-sacrifice; it returns to him, christened and imbued by the larger life of which for a time it has formed a part. The brain cell could never have attained its present estate but for the greater personal life of the organism in which, for a part of the time, it blends itself.

For the point to be kept steadily in view is, that cell

life, perfect enough not to die, but live on continuously, is a question and merely a question of excellent food, protection from injury and germinal renewal, and not that death is a final "law of nature," as a false eschatology has hitherto taught mankind.

If the science of biology teaches anything, it teaches this truth of the possible deathlessness of cell life on the earth; and this truth is to the last degree important and revolutionary. The doctrine that death is a final "law of nature" has been made the cornerstone of that other cardinal doctrine, namely, the "disembodied spirit" myth. With the refutation of the doctrine that death is a "law of nature" will fall this latter doctrine of disembodied souls. For it will no longer have a *raison d'être*. In its place will come that grander gospel that *life* is the "law of nature," not death, and the demonstration, long overshadowed by errors of theology, that the "kingdom of God" is a natural development of life on the earth.

Two millions of centuries have struggled forward in pain and travail to make the human brain capable of the human intellect. It is a priceless heritage, the great ancestral estate of humanity. It is not destined forever, nor much longer, to be lost in death; we shall carry it through to a greater destiny. The true scope and intent of life is now just dawning in the minds of men. We are waking, — after idle dreams, — waking to what we can do and be, waking to the great possibilities of science, wak-

ing to live, instead of resigning ourselves to death and mythical promises of ghost life.

But how? How will this be accomplished? Granted that the cells of the human brain may live for a century, the entire human organism still dies and the cells perish with it. How will this fate be altered or averted?

The answer is plain. It is already outlined and indicated in the manner and the means by which the cell has prolonged its lifetime from a few days to a century. We have but to study the rise and progress of the physiological cell. Its life history is set before our eyes in the animal organism. By union, organization, differentiation of function and division of labor for the common weal, this long-perfected animal organism has been developed. But now, to carry its development forward and immortalize the component cells, an onward step in organization is necessary. The human individual must be made the unit of a greater system, even as the cell has been the unit of the animal body.

And this greater system of union, organization and division of labor has already been initiated, unconsciously, it may be said, on the part of mankind. For thousands of years human beings have been banding together to this very end, unconscious of the real purport of their effort! The personal ends which, individually, men have had in view, as the motive of their labor, eventuate in a greater

achievement than they wot of. For it does not follow that the human intellect, composed of cell sentiences, can always comprehend the outcome of its acts. The intellect is not yet sufficiently consentient to perceive and understand the deeper instinct of the component cells. Instinct, of which we have heard so much, is the dimly perceived motive and will of the cells.

But, as has been said, an organization by consentient or "protoplasmic" contact, human being to human being, is impracticable under the laws of terrestrial matter and undesirable for ideal and economic reasons. We therefore resort to a better kind of union and organization — better because it affords greater individual liberty, based on intercommunication by the use of abstract signs and symbols, and also impress the more ethereal states or modes of matter into our service to accomplish intercourse; so that personal feeling and thought (which is the feeling of the brain-cells) can be freely communicated from individual to individual, as freely and intelligibly as if by contact of protoplasmic filaments. Protozoons, indeed, might never have united to form metazoons had they possessed anything like human facilities for intercommunication. They were dependent wholly on touch and feeling, and on this sentient basis the animal organism, which we inherit, grew up.

The extent to which this humanly developed system of intercommunication has progressed need not here be de-

scribed. Language, commerce, education, the industries, arts, sciences, law, religion, medicine and the entire social order have come forth and grown up from it. Mails, transportation, telegraphy and telephones are adaptations and inventions to effect a larger intercourse. In fact, the means and facilities for communication are now ample. It is not lack of these which delays the progress of humanity. A most rapid advance is possible. The obstacle to progress is the *lack of the spirit of cooperation, lack of confidence and good-will, lack of understanding of the real situation*. Instead of this essential good-will there is suspicion, envy and hatred, which pave the way to violent acts, war and destruction of the hard-earned fruits of labor.

It is the same ancient dislike of self-sacrifice seen in the protozoon, which so long delayed metazoic life; the same unbelief that the merging of self in the community will redound to the benefit of the individual; the same reluctance to work for the common weal; the same self-love that makes so many millions of our fellows unwilling to share and share alike with others, blinded to the fact that their greater happiness lies in just that act of self-surrender! Blind, too, to that other greater fact, *that along this line of self-sacrifice and cooperation alone lies salvation from disease and death. This is the Way.*

Just as the cells unite their lives and work together for the common good, so must the citizens of a nation or

country devise methods and form habits of united effort, to accomplish great ends. The first step to this is good-fellowship, good will one to another, mutual confidence, and a determination to cooperate. There is no other way. Selfishness is retrogression. The way to enduring life is through consecration of self to the common good. This is the lesson from the cells. This is the method of nature. By following this method, for example, multicellular man may live eighteen thousand years. He may live forever.

In unicellular life, no separate single cell, by any device, or husbandry of its life, could have lived a century, or a year. It is only by union and self-consecration that the long-lived organism has been developed and the neuron become a partaker in its longer life. And even so in organized, perfected humanity the component individuals will become macro-biotic.

By united effort all are raised up to a higher plane of life. Faulty and imperfect as it is, human civilization has doubled the years of man. Twelve centuries ago the average length of a human life in Europe was evidently less than eighteen years. But compared with what science could do with its present resources of knowledge, existent civilization is but the most rudimentary of organizations. The effort at an advanced civilization is barely inaugurated, as yet. All the great results are to come.

The only obstacle is ignorance: ignorant distrust, ignorant hatreds for creed's sake, or for race's sake; fatuous

ideals of patriotism, forgetting that all men are brothers; insensate ambitions to build up one nation in wealth and political power at the expense of the rest of the world, reckless of the refluent wave that will sweep it away in blood and loss.

The priests and preachers of Christianity have made but a feeble progress in convincing the world of the truth and utility of this great doctrine of Jesus, because they have not comprehended it themselves. They have understood neither its scope nor significance. The great doctrine of brotherly love and human equality has been preached rather as a sentimental tenet, a species of Sabbath-day duty, a symbol of allegiance to the church, a kind of holy discipline for the soul, to prepare it for "another world." They have missed, lost and sacrificed the power of the golden rule as an agent for controlling and elevating mankind, because they have made it a shibboleth of church membership rather than a prime requisite of human progress. The real significance of this doctrine has yet to be made plain to human eyes; its real strength has yet to be manifested. Then, not till then, will the human race accept it and act on it. This deeper-lying truth of life has yet to be instilled in the mind of humanity. Church Christianity has never evinced an understanding of it, perhaps never can have an adequate comprehension of it, as long as the "kingdom of God" is believed to be an immaterial realm of disembodied spirits

in some unknown quarter of the universe. The Son of David distinctly and repeatedly claimed to be the Hebrew Messiah, the realization of the prophet-promise of Jehovah to the patriarchs. He is a rash commentator who asserts that the Beni-Israel ever believed this promised Messiah to be other than a terrestrial one, the founder of a kingdom of God and of Israel on the earth. There has been a fatal break in the facts of Scripture here, an insincere compromise with Zend-Avestan spirit myths, which has always weakened Christianity as a world faith, and from which science will now shortly compel it to purge itself or fall.

The golden rule is no sentimental phantasy of an exalted dreamer, but a matter of human utility and necessity. This is the Way, and until it is adopted, nationally and internationally, mankind will stick and pause in its onward career. It is a prime requisite to the farther progress of human life, and as such must be recognized by civilized man everywhere. It is that greater Christianity which is yet to come.

The difficulty of initiating an era of good-will and mutual cooperation lies not so much in the perversity of men, individually, or their inherent unwillingness to make those needful sacrifices, as in our present inability to bring about a world-wide understanding and to secure

common consent of all parties and peoples. Thousands, yes, millions of the dominant race, are convinced that the highest good of all lies in an unselfish federation and organization of all terrestrial interests. But there are the alien races, speaking other tongues and intensely jealous of the dominant race; and even worse, there are the oppugnant religious systems, each claiming to hold all the truth in the universe, possessing each a supreme deity and sacred ritual of its own, and denouncing the votaries of all other systems as enemies of Good and emissaries of Evil.

Strangely enough — where the converse should hold — it is religion which will longest bar the coming of “the kingdom of God ! ” Sadly enough, too, it is not those tenets that pertain to life on the earth which have set sectaries so inveterately apart, but doctrines concerning future paradises and gehennas.

The saddest spectacle which the earth presents is that of the zealot millions ready to carry war and devastation, from continent to continent, in the name of Allah or Jehovah. If the biologist ever utters a prayer it is for human deliverance from religion in the fossil state. If one world-task looks harder than another, it is to redeem the human brain from the incubus of religious indoctrination, and set it natural again, capable once more of a normal perception of truth. Herakles of old might have blanched at that labor.

For the brain is "formed" and the courses of thought molded to doctrinal ideas, taught by church authority. When these doctrines have been inculcated for centuries, and then found to be wrong, the task of rectification is a most disheartening one. Considered in gross, the entire brain of humanity, at present, is under the spell of erroneous creeds, and does its thinking along perverted channels of mentation. The belief that this earth is merely a place of probation for heaven after the death of the body is the worst possible initiative for the achievement of that natural salvation which is, and has ever been, the real goal of life. Mankind cannot rise in opposition to its own faith, nor will the effort to attain a natural salvation begin in earnest until the truth and the facts concerning the soul of man are understood and accepted.

The inference and argument for natural salvation have brought us, step by step, from the protozoon to that wonderful congeries and federation of cells, grouped about the cerebro-spinal axis of man ; in other words, to man in his present imperfect social organization ; his blindly selfish attitude to his fellow-beings ; his weapons and engines of destruction ; his standing armies and navies ; his wars and his antagonistic creeds. That confident cooperation and good-will to his fellows, necessary to organize humanity for its crowning achievement — the achieve-

ment of immortal life — have yet to be inspired in the hearts of men ; and the point to be kept in view is, that this is the inspiration imperatively necessary to future progress, the sine qua non of the human situation.

No gift of prophecy, no skill of divination, is required to forecast what might be done on our planet in half a century of good-will and cordial cooperation among men. When the billions of hard-earned wealth, now wasted in war and warlike equipment, are applied to research, discovery, invention and the general application of knowledge to the amelioration of human life, then will begin an era of human advancement to which all previous progress is as a fitful starbeam to the glory of the rising sun! Dull is the mental vision of him who cannot discern this promise of our incipient sciences. It will surely come ; but it might come speedily, before the year 2000. It will come from the combining of all human knowledge, the joining of brain to brain by mutual incentive, like cells of an electric battery joined to raise strength of current, to secure that consentient elevation of intelligence which will carry achievement to an ecstasy of enthusiasm and great hope.

There is inventive talent enough in the general brain of mankind, now lying inactive, unemployed, or perverted, to obviate most of human ills, could this talent and genius be given opportunity and incentive, and be organized for work.

Fifty years of such organized effort would usher in achievements even to predict which would now be thought visionary. Fifty years of confraternal endeavor would so perfect locomotion and transportation that journeying to any portion of the globe could be accomplished in from three to five days, accomplished in ease and comfort, and with a fair degree of safety.

This of itself would be the first and best step to effacing the ancient antipathies of race and religion. The formula for introducing the Golden Rule among men is intercommunication versus ancient isolation.

Within fifty years, perhaps much less, we might come to understand the internal economy of the cell-of-life, and might master the problems of its reproduction. These problems are already outlined; but we are still ignorant why the somatic cells wax and wane, from youth to age; or more explicitly, what charge of ions, "biophors," or "gemmales" is concentrated in the cells of the germ-plasm; how this marvelous recharging of life from generation to generation is accomplished; why the commingling of cells from the two sexes is advantageous, or requisite; and, in general, the nature, chemical composition and mode of production of these minute germ elements of the organic tissues.

These are studies and discoveries which urgently wait the scrutiny of earnest, well-equipped students of our science. That they are beyond human discovery might have

been believed once, but will hardly obtain credit in our times. In fact, we are on the brink of such discoveries.

We need to know the composition of the animal ovum, of what the germinal matter consists, how and whence it arrives there, and how it may be produced artificially. We have to discover what selected components — ions, electrons, psychons, or biophors — this animal ovum is composed, to the end that the various tracts of somatic cells issue from it and coordinate in the tissues of the organism. We have to learn on what actual physical basis old-aging proceeds: whether as animal life goes on, the tissue cell is slowly depleted of its initial complement of germinal matter; whether the original "charge" of ancestral life-germs is gradually exhausted in numbers or potency; or whether the contents of this body cell are homogeneous, and old-aging ensues from imperfect foods and the ravages and deleterious products of bacteria.

In short, we have to learn whether the somatic cell runs down, like a water spring, from expenditure of its concentrated biophors, or whether it is simply smothered, poisoned, slowly encysted and suffocated by the weathering, infiltration, and induration of the tissues in which it lies embedded. Whether old-aging is a slow form of starvation from the contraction and hardening of the capillary walls and the thickening of the lung membranes.

Or yet, whether all these causes operate together,

namely, slow starvation and suffocation, combined with depletion of the inherited germinal matter.

For exhaustion or expenditure of the vivific units of the somatic cells, some process of inoculation, kataphoresis, or inward radiation of ions may be devised; for the progressive suffocation, poisoning-out and starvation of the cells, an amelioration of all the conditions of life as we now live it, must be accomplished, viz., the extermination of bacteria, purification of the atmosphere and the use of foods adapted to protoplasmic renewal; all purely physical problems and properly the subjects of scientific research; and all in line and continuation of that natural salvation of the cell-of-life from accident, disease and death, which has been in progress since life began on the earth.

Parent and child, through a hundred generations, constitute but one human personality, pressing forward, in time, to become something better, wiser, more powerful and happier. The parent dies and the child succeeds, but at a vast loss of knowledge and of time, not because death and birth are the ideal or ultimate laws of life, but merely because we have not yet acquired sufficient knowledge and power to escape death. The human personality, incarnate, living on from century to century, conserving science, able to renew itself and resist all the vulgar agencies of decay and death, is the ideal human being, not a chain of parents and children.

But life, as we now live, is one long contention with

accidents, bacteria, improper food, duress of climate and hostile fellow-creatures. First the cell was driven to a mode of reproduction, to escape extinction; multicellular creatures developed from cells and may be said to have inherited the reproductive mode of life. Humanity has arisen from its lower ancestry to its present estate, by virtue of the reproductive, alternate mode of life. Hence, to die appears to many persons to be as natural a fate as to be born; yet when more closely examined, death is seen to be an unnatural event, a result of hardship and distress, a fate repugnant to life everywhere and a catastrophe to be escaped.

The Weismann hypothesis of life, death and heredity is so well known and so generally accepted, in part, among English and American biologists, that an extended statement of it is unnecessary here. It has taken its place in our science; and the two important modifications to which it must be subjected are now fairly well outlined. Professor Weismann has been termed the Darwin of cell development; to the present writer it seems that he might better be called the Lamarck, and that the Darwin of the animal cell has yet to appear.

Weismann's positions are (1) that death is not an inherent necessity of unicellular life. The unicells do not die, but divide, giving rise to offspring by fission. "No

amœba has ever lost an ancestor by death." Weismann defines death as "a definite arrest of life. The proof of death is that the organized substance which previously gave rise to the phenomena of life forever ceases to originate such phenomena." Death implies the presence of something dead. An amœba, for example, produces offspring by dividing into two amœbæ. By this act of fission the parent disappears in the two children, but has not died. Hence arises Weismann's conception of the natural immortality of the protozoons. The protozoons die only from accidents of heat, cold, or violence. This view, however, has now of necessity to be modified.

(2) These deductions apply not only to protozoons, but essentially to all living creatures which produce offspring by fission; and it is on this basis that Weismann has built up his theory of the origin of death, briefly this: Since amœbæ and other unicells which reproduce by fission are naturally immortal, death must be regarded as peculiar to multicellular organisms (metazoa). In the metazoa where the cells are organized with differentiation of function, there are two distinct classes or groups, those which develop to form the animal body (soma), and the reproductive cells, confined to the generative tract. The former (somatic cells) grow till the organic limits are reached, live for a time and fall into senescence; the latter (the reproductive cells) are the units from which the next generation will be developed. The somatic cells are

concerned only with the life and welfare of the individual, the reproductive cells with the continuance of the species. Of the two classes of cells the reproductive live on from generation to generation, never die in fact; the somatic cells alone are subject to death. The reproductive cells are immortal, as the amœba is immortal; they die only by the — to them — accident of the death of the body.

(3) It is an error to regard the animal or human organism (*soma*) as the essential or important part. The reproductive tissue (*germ-plasm*) alone is of importance. The *soma* is subordinate and exists for the purpose of carrying forward the *germ-plasm*. It is its vehicle of life, exists for no other object, and has no other *raison d'être*. In the opinion of Professor Weismann, the human brain exists solely for the purpose of nourishing, protecting, and bearing forward the group of cells lodged in the organs of generation.

(4) He further holds that the origin of death is found in the consideration, that it is advantageous to the species that the individual animals, or humans, shall die. "If for a moment we imagine that one of the higher animals were to become immortal, it is perfectly obvious that it would cease to be of value to the species to which it belongs. On one hand, there is the necessity of reproduction, on the other, the utility of death." He argues that the duration of individual life is, in all cases, that which is best for the species. For example, the May-fly lives but a few

hours, because no more time is needed for depositing her eggs. With mammals, on the other hand, years are required for the rearing of offspring sufficient to make good their places in nature.

(5) With regard to the proximate causes of death, Weismann holds it to be due to the somatic cells losing the power of growth and multiplication after a certain length of time, or a certain number of cell generations. "Length of life in the individual is dependent upon the number of generations of somatic cells, which are able to succeed each other from the original endowment in the ovum."

(6) As regards heredity and inheritance, Professor Weismann discredits the common opinion that the personal lives, habits and efforts of parents affect the character of their offspring. His theory of a distinct germ-plasm controverts the concept of Darwin that "gem-mules" from all the somatic cells are garnered up in the reproductive cells, and thus reduplicate the parents in their offspring. Nothing of this, from the soma, is conveyed to the germ-plasm, or affects, save in extreme contingencies, the reproductive cells.

Like Herbert Spencer, Weismann conceives that life on its lowest plane, unmodified by environment and unorganized, exists through or by virtue of "physiological units," which he, however, terms *biophors* (life-bearers), a conception not unlike that of the *plasomes* of Brücke, or the *plastidules* of Haeckel. In the lowest forms of

life, the biophors are little organized ; but, under the influence of the environment, as evolution proceeded, the biophors assumed certain persistent relationships to each other and formed themselves in fixed groups. Such groups determined the character of the cell, and to these Professor Weismann has given the name of cell-determinants.

Numbers of determinants are associated in larger groups, termed *ids*, and *ids* again as *idants* : relationships of biophors which form parts of the centrosome and chromosome of the cell.

(7) It is Professor Weismann's conception that death — touching its origin — is intimately connected with sexual reproduction.

That the protozoons are naturally immortal and that death is confined to the metazoons has been refuted since Professor Weismann put forth his hypothesis in 1881. Maupas has shown that certain protozoons exhibit the phenomena of senescence and die out from intracellular causes ; also that protozoons conjugate sexually and are thereby restored. The hardship of the terrestrial habitat affects even the lowest, simplest forms of life, perhaps even the "biophors" themselves. The latest advances in physics indicate that "atoms" tend to waste away, and future researches may prove that the ions and electrons are not stable units. Avoiding death is less a question of ultimate, incorruptible atoms than of making scientific repair excel natural waste.

That many groups of the somatic cells tend to senescence and exhaustion, in time, is apparently true, but this tendency should not be looked upon from the standpoint of the fatalist. Beyond doubt it is a tendency and a condition which can be remedied. The science which discovers the condition, will ere long discover the remedy. The brain group of cells tends least to senescence.

It is but natural that having brought forward his hypothesis of the germ-plasm, Professor Weismann should attribute a leading rôle to this group of cells and give it marked prominence. This is seen in his unqualified assertion that the individual exists solely for the purpose of bearing forward the germ-plasm from generation to generation. This deduction is true in a sense, but hardly in that sense of finality which Professor Weismann is inclined to ascribe. Beyond doubt it is difficult to say why life exists at all. The purposes and intents of creation are not as clear to the biologist as to the theologian. Professor Weismann holds that the individual animal, or human, lives as long as is necessary to bring forth and foster offspring, no longer, then dies because its death is necessary for the good of the species, or, strictly speaking, the good of the germ-plasm. If this assertion, with its incident fatalism, were restricted to evolution in the past and cast no black shadow on the future of evolution, it would be more rational, less repugnant to the bond "individual," who is made to play the rôle of a hopeless

serf of death. We cannot resist the conviction that ultimately, at least, the germ-plasm exists or will exist for the good of the individual, not the individual for the germ-plasm; that the brain group of cells is of greater consequence than the generative group. But again we admit that it is rash to say that anything exists for any purpose whatever. Purpose, conscious purpose, does not come in until there is brain. There is apparently no purpose in lower nature, or if a purpose it appears to be an unconscious one.

According to the Weismann hypothesis, the reproductive cells give rise to offspring by virtue of the permutations and combinations of their own constituent biophors; the somatic cells do not contribute to the germ-plasm either from their substance, nor otherwise. The soma, indeed, grows from germinal matter in the reproductive cells, but exerts little or no influence upon that tract. The germ-plasm lives apart and to itself, and is sufficient in itself for all which we know as heredity, unaffected by the life or culture of the soma.

But when we consider the intimate relation in which the reproductive organs stand to the whole organism, when we contemplate the close nervous connection and sentient sympathy between this group of cells and the brain, when we consider the constant streams of electrons which are poured to these cells from the brain and other organs of the soma, when we picture the steady circulation

or ions from the brain cells through these cells — it seems well-nigh marvelous that this group (the germ-plasm) should be so little affected, so little modified as Professor Weismann would have us believe.

Later researches afford indications that the intimate causes of old-aging are resident, primarily, in the cell nucleus. It has even been held by one observer that the cell nucleus lives, individual and apart from its cell host, originally intrusive and parasitic. But if so, it has become so well domesticated as to participate naturally in the life of the cell.

The nucleus is found to be made up of a series of granules, composed of a substance chemically rich in phosphorus, to which the name of *nuclein* is given. These granules take aniline stains very readily, and are thus seen to be connected one to another by the substance *linine*, which is not colored by the same dyes. Thus examined in old and young cells, the quantity of nuclein in the latter is found to be so uniformly greater in many instances that the deduction is made that there is a progressive diminution of nuclein granules from youth to age, as the nucleus divides, giving birth to new generations. As the nuclear granules diminish, the somatic cell falls into senescence, sinking to a condition where fission ceases. For a long time it rallies and divides again, but produces an enfeebled

offspring, till finally it encysts itself and forever ceases to be parturient. The present theory is that no new nuclear granules are engendered in the somatic cell. Like the worker-bee in the apiary, it is differentiated and specialized beyond the power to produce offspring. In like manner isolated ciliates lose the power of reproduction, unless opportunity is given them for conjugation with other individuals.

Brown-Sequard conceived the idea of reaching and restoring the somatic cell by injecting triturations of reproductive glands, as medicines; and beyond doubt methods of restoration by inoculation, or vivific foods, will be discovered.

The rapidity with which the remotest tracts of cells in the organism are influenced and permanently affected by the introduction of minute quantities of remedial substances into the blood-circulatory is now well known to the medical profession. Such inoculation affords more direct access to the cellular seats of life than the alimentary tract with its modifying acids. The blood is in immediate relations and actual close contact with the cells which, in all cases, must be reached before remedial effects are produced. Nothing acts in the animal organism until the cell is reached and its sentient economy affected. Many eminent physicians are, therefore, of the opinion that injection into the circulation offers the best method of administering certain medicines.

Inoculation to produce immunity from diphtheria, small-pox, hydrophobia, *et al.*, has been successfully practised for many years, as also by veterinaries as tests for tuberculosis. The procedure is in its infancy, as yet, but is one of great promise, since it is the cell which must be acted upon, and the rapidly propelled blood, reaching it almost instantly, comes in touch with its sentient surfaces. As soon, therefore, as we can discover and compose regenerating substances, or those which will stimulate regeneration, the blood-circulatory affords an efficient route to every cell in the body.

What these substances are, we do not yet know, whether artificially propagated nuclein, or reagents which stimulate its growth *in situ*. But if anatomy and histology offer us one hint more significantly than another, it is that the blood may be made a breeding-ground for the regeneration of the somatic cell. Five thousand well-equipped investigators, starting off with enthusiasm and rivalry to study this problem, would hardly fail in twenty years to set us far on the way to the control of all life. What our rich men spend yearly in their vacuous craze for horse-racing alone would more than equip and maintain these researches. Such inane squander and misdirection of the world's hard-earned money cries down Heaven's condemnation. But they know not what they do! Misled and bewildered by erroneous creeds and futile ideals, they know not how otherwise to

spend the millions which they even believe belong to them.

A hopeless phase of thought has come to many biologists from regarding the ordinary course of nature as final for the human race. Whereas, nothing is more probable than that we shall come to direct and control the processes of nature in the cell. What takes place in the nucleus and the causes of nuclear exhaustion will yet be found a very simple chemical problem. The control of life in matter is unquestionably before us; the entire progress and trend of research look to such achievements. But for this outlook of hope, we might well accept the dictum of Bichat, that "from infancy we die, day by day." The cells of the *soma* develop in a certain way and to a certain end; nor is there the least likelihood that the human organism of its present physiological bent would ever reach great length of life.

We mean that the somatic cells, unaided by the human intellect, would continue to produce an organism, subject to growth and decline. The ancestry and nuclear endowment of the cell carry it to a termination of its activities. This is more apparent in the dark-skinned races of mankind than in the dominant race, and still more evident in the lower animal orders.

Lower unassisted nature would live and die in alternate generations as long as the earth offered a foothold for life. The chemical affinities and electric tension of terrestrial

matter foster this method of vital expression. There would be little hope of anything much better or longer-lived. The earth is not, in its present condition, a habitat for deathless life. Its inclemency, its extremes of heat and cold, furious winds, hours of darkness, variant electrical condition and, more inimical still, its hordes of hostile bacteria, — all are against enduring life-forms. We see, therefore, that in a manner the primary instinct of the early races of man is right; this earth, unregenerate, is not the place for immortal life. Some improved condition is to be sought for that, some promised land, some realm of godhood. Not till this century has the vision of all these human ages begun to be interpreted. Alchemists had dreamed of a sporadic immortality by magic potations; but not till now have men come to see that vastly prolonged life is to be the outcome of brain evolution.

We look up to the disk of the earth's older sister planet and see its surface spangled with a strangely familiar geometry: parallel "canals," or belts of vegetation, and at the intersection of these canals "oases" which may be the Martian realization of "heaven," from which the germs of disease have been excluded. What interplanetary rivalry in good works do those "oases" suggest! Will our earth ever turn its face to the gaze of the universe, seamed by such giant engineering?

When we ask the question broadly — Why does the human body grow old and at length cease from function? — putting the inquiry in the bio-physical sense, the answer seems to be that the personal life embodied in the organism is at length overcome and overmatched by the totality of the resistance to life which it encounters, from the embryonic stage onward; more specifically, to the general telluric resistance, physical, chemical, molar, molecular, which the protoplasmic molecules of the organism meet with, as long as they maintain the personal life. After adult age is reached, they lose ground in the struggle and at last succumb. The downward curve of the somatic cell has begun. But there is a period, during adolescence, when the cells gain ground, when they make head against the terrestrial resistance to life and prevail joyously, with a sense of victory; when the inherent energy of the personal life is more than sufficient to breast the opposition.

We have, therefore, to picture this personal life of the cell as an impulse which for a time rises superior to the resistance, then slackens and falls away to cessation.

Yet its source in matter is apparently a constant in nature, inseparable from the material ion, and persistent in matter at a uniform tension. Why then, in the human organism, is it exhibited thus intermittently, as "wave motion"; in adolescence and senescence; in youth and old age?

The answer is that human life, even as waves on the

ocean, or sound waves in the air, has fallen into the rhythmic, wave mode of life, as a general result of the terrestrial resistance to life; and that the cessation of vital energy, seen in aging organisms, is apparent rather than real, marking a transfer of life from one generation to another.

The transfer of life by means of the reproductive elements, and the subsequent death of the parent organism, is a mode of life into which all animal orders fell far back among the earliest metazoons, if not in unicellular life itself.

It is manifest, too, that this tendency or life habit of humanity is very deeply rooted in the cellular elements of our being. The cell determinants are cast for growth and decline. Sterilization of the reproductive tissue in the individual, removal of these tissues, or the most rigidly enforced continence have little or no effect as regards the aging and death of the organism. The tendency of the body to follow its inherited cycle of growth and decline is inveterate, and not to be changed by the exercise of the will. Something, indeed, this will-power of the personal life may effect, but not that radical transformation of being which the perpetuation of the individual implies. It is to our science that we must look for prolonged life.

Procreative desire rapidly slackens in individuals to whom life offers sufficient attractions to live on for life's higher, more refined pleasures; and in this circumstance

we have a certain earnest of evidence that the higher intellectual life of the future will physiologically redound to a prolongation of individual life. Decline of the procreative instinct follows naturally when the individual has hopes of surviving ; and such decline and self-continence react to prolong life ; yet centuries would scarcely suffice to alter the deep-seated trend and course of our ancestry. It is to our sciences — the superior intelligence of brain — that we look for aid in prolonging our lives. Man has already passed the point where he relies for his progress on the tedious course of terrestrial nature unassisted. He reaches forth a Promethean arm and, in the light of his stores of knowledge, bends lower nature to his wishes. We expect to bring our sciences to act upon the cellular basis of our lives and accomplish its regeneration.

Under low nature, man would never surpass the purely animal cycle of organic growth and decline ; of adolescence, maturity, and old age. It is only by rising superior to the lower course of nature that man has become something more than an animal order of life, recording experience in written language, kindling fire, smelting the metals, impressing the lower animal orders into his service, and even dominating the forces of nature, in order to travel by steam and speak around the globe by electricity. He has put lower nature in harness and now directs natural law.

In view of these grand victories, why should he despair

of altering the lower course of nature in his organism and of directing the life of the cells of which his tissues are composed? The question is a novel one, in this sense. Hitherto, biologists have assured us that we must be content to be what inheritance would make us. That is the old cell doctrine in a nutshell. Weismann and, in general, the German, English and many American histologists base their theories of life on this assumption, namely, that the ordinary course of nature must be final as to man's future. Nature is fate.

But brain is higher nature, the acme, at present, of natural development. Everything which makes man a civilized and enlightened being has been obtained by brain mastery of lower nature and the diversion of her ordinary courses to his advantage. Why should we not expect to thus arbitrarily change and facilitate the nutrition and life of the cell? In point of fact, that is what has been done and is being done constantly in a hundred ways already. The position of not a few biologists on this question to-day is much as those who would argue that since a man can walk but fifty miles in a day, afoot, by his natural means of locomotion, or swim but twenty miles, he can never go to San Francisco in less than sixty days, or reach Liverpool in less than five months. Three hundred miles per day are as natural to brain as twenty miles to muscle.

It is to science that we look for the control of cell life.

Biological science, it is true, is still in its infancy, but it is a very hopeful infancy ; and it is the opinion of many of its best exponents that within another quarter of a century we shall have penetrated the secret of cell nutrition and growth, and opened the way to a scientific renovation of the tissues.

But faith has to be engendered as well as discoveries made. Enlightened man, indeed, is but just awakening to the idea that he may possibly escape death by setting his wits to work to this end ; and, as ever, there is the olden outcry of impiety raised against the conception, as if it were wrong to try to live ! As if it were not natural to live on !

But greatly prolonged life implies an amelioration of all the conditions of the terrestrial habitat, and within fifty years well-nigh complete control of the aerial currents and rainfall might be attained, if only a modicum of the intellect of the race could be concentrated upon these problems. This achievement will go far to bring about that physical paradisaic of the earth, needful to redeem it from the imputation which it has so long endured, of being “a dreary bourne” and a place of exile to homesick souls who long to flee away to some better land. The earth will yet be made one of “the garden spots” of the universe. It is a purely physical problem, and not a little of the data for its solution is already in our hands. Foretelling the weather is the first step to controlling the

weather. It is a question of the electrical distribution and regulation of the solar heat which falls on the earth's surface, and the direction of the "trade" or retro-rotary winds due to rarefaction and the earth's axial motion.

The electrical distribution of the earth's share of the sun's radiation will make it possible, not only to regulate the rainfall, but gage vaporization from the ocean and lakes. Droughts and freshets, tornadoes and frosts, might soon become disasters of a past age, if the resources of control which are already coming within our grasp can be applied. What is expended in national preparation for war, in a single year, would suffice to initiate the preliminary plants and stations for experimentation in heat distribution.

Climate is as much a terrestrial condition to be controlled as a city's water-supply. A bad climate will be quite unnecessary in the year 2000. The problem of irrigation is properly one of a regulated rainfall rather than of dams, canals, or artesian wells. Vaporization and rainfall are the factors to be controlled. An equable distribution of solar heat and a regulated electrical tension are the agencies to be used to this end. The whole problem of climate-control is already outlined in physics, as to its methods. We need but the wasted war appropriations and the labor of idle soldiers to put it in operation.

Such a half century of rational cooperation would see even more revolutionary advances in our methods of

communication, now effected by mails, telegraphs, and telephones. Not only will messages and general news be transmitted, electrically, but be accompanied by photographic and phonographic representation of passing events. But of far greater significance to life, its prolongation and improvement, will be the conquest and extirpation of those teeming hordes of bacteria which infest the animal organism and render all organic life abnormal and precarious. Human life in the future is to be liberated not only from known "germs of disease," but those swarms of less deadly, but yet deleterious micro-organisms of which the human body is the host and which, by their presence and products, enfeeble life and maintain diseased conditions. The human body must be regarded not only as living amidst and externally exposed to microscopic life of a hostile and noxious character, but as being infested by such life which entering the blood-circulatory either with food, water, or air, penetrate to every tissue and organ.

Ninety per cent. of all human casualties are either directly from the presence of micro-organisms, or induced by the more or less remote effects of their activity. The extirpation of bacteria will be a long step toward the achievement of vastly prolonged life. Like all the others, it is a purely physical problem and only waits combined action on a great scale on the part of mankind. The habitat of man has to be purged and cleansed from these

now well-known causes of death. The task is too great to be undertaken by individuals, and remains over for the organized effort of nations and races.

All life which is really living and worth living is progress; and an interesting feature of the next fifty years will be presented by improved human habitations. A new type of dwelling has already appeared in the larger communities — a communal house — admirable in its sanitary arrangements, ventilation, heating and lighting, with a common kitchen, relieving the individual heads of families from the costly and unnecessary drudgery of so many small, isolated cooking-places. The lofty steel and brick city apartment house, however, bids fair to be replaced for much of the year by a country habitation, located apart, amidst rural surroundings, and of no greater altitude than three stories, but of large ground area. Such communal dwellings, for four, six, or eight families, will have all the perfected equipment of the larger city apartment house, and, in addition, private gardens, groves, orchards, and rural scenery.

The kitchen will be a joint or cooperative effort, but attended by difficulties and trouble. For it is the question of improved food which will longest baffle the genius of the chemist and biologist. Nor need this be a matter for surprise. Nutrition is the problem of the coming age, *par excellence*.

Food, as we at present view it, seems a simple matter. The lower animals and plants afford it. It has but to be herded, cultivated, harvested, and cooked. What more simple? But of all future inventions and discoveries, some of the greatest, the most important, will pertain to food.

At present we ingest the *errata* of plant and animal life. "The dead, alas, are in us," and "death is in the pot"; but less that our foodstuffs contain poisons than from lack of organic energy to maintain the complicated apparatuses requisite to reduce and make it ready for assimilation by the tissue cells. It is our food which renders greatly prolonged life impossible, at present. Nor is it probable that the human organism ever was, or ever could be, bred or trained to live forever on food such as human beings now eat. The physiological processes by which food is reduced, comminuted, corrected as to its chemical constituents, peptonized, hepatized, oxygenated, and, in a word, carried forward to higher and higher stages of chemical instability, fit for assimilation by the tissue cells — all these processes set up a heavy draught on the collective, organic life of the animal body, and necessitate the putting forth of energies, on the part of all the cells, which cause an ever-increasing deficit of potential, a growing debt from overwork, a chronic accumulation of the effects of fatigue, which, under present conditions, must sooner or later lead to a running down of the cells.

Under favorable conditions, a cell may gain potential; but the severe, steady draught on cellular energy, necessary to maintain organic nutrition, even on the best food at present procurable, bankrupts the collective energies of the cells within a century.

The horse, ox, and other ruminants that have to do even more hard grinding and furnish more energy, relatively, to maintain nutrition, succumb much sooner than man.

In one sense, therefore, it is our food which brings us to death's door, that is to say, the exhausting physiological processes, necessary to prepare it for cell nutrition, will in the end work the most perfect existent animal organism to death.

It is only when the organism is young, the lungs pervious and the tissue cells little encysted as yet, that a gain in cell potential, for fifteen or twenty years, can be made over the draught on vital energy, requisite for nutrition.

We may properly attach great significance to these facts, since the general opinion is, that food, once eaten and drunk, reaches its proper destination in the body, without much expenditure of energy. Yet sudden death not infrequently follows over-feeding, purely and solely from organic inability to summon sufficient power to initiate the process of food reduction.

It is along the line of improved food, as well as re-

generation of the somatic cell, that we must look for happier and longer life.

Is such a food possible?

Beyond doubt. But at present we lack the data of nutrition. We do not as yet understand how a cell nourishes itself, nor how it might best be nourished. The cell absorbs particles from the blood plasma, and we have a general knowledge as to what those particles are; but of the modes and processes of intra-cellular digestion and nutrition we are ignorant. We do not know how much of that food is actually assimilated in the cell, nor how much is rejected. Beyond doubt the blood is a comparatively dirty stream, and it is probable that the cells suffer constant injury from the dirt which they ingest. The intestinal tract, or passage along which the ingredients of the blood are prepared for the villi to engorge, is literally a howling wilderness of disgusting parasites and bacteria, many of which are hostile and destroy the life of the host if they multiply beyond certain bounds to which the *vis medicatrix* of a healthy organism keeps them down.

As a first step in the study of improved food for the future we have need to see what the primitive cell — the protozoon — has done in this line. For better food has been the object of long effort, since the first micro-organism appeared on the shores of the primeval sea. Protozoons like the rhizopods, encysted food particles which,

laboriously, with an exertion of all their powers, they contrived to reduce, digest, and in part assimilate. It was a hard life into which they put all their energies; and to their humble efforts we owe a debt of far-off sympathy. One can but think softly of those first toilers in the archaic marshes — so much depended on them.

The protozoon had his small stomach, an improvised colon, and maybe a unicellular liver; and beyond doubt our ancestral rhizopod had his colics and his jaundices, and was often in mortal agony from terrific peritonitis. It could hardly be otherwise, considering what awful food chunks his hunger drove him to surround. But he struggled through, by hook or crook, and finally drifted into metazoic cooperation; and thus took life a little easier.

For after locomotion, better food was the first problem which multicellular creatures undertook. The animal organism, with its blood-circulatory, blood-corpuscles, blood plasma, cardiac apparatus for propulsion, and lung tissue for æration, offers a most interesting and suggestive study of the way the protozoon, in its later rôle of physiological cell, has handled the food question. It is the object lesson of the protozoon to the human metazoon.

To secure better assimilable food for brain and muscle the confraternities of metazoic cells, very early in the division of labor, constrained a certain number or tract of cells to act at first hand on food substances and make that their peculiar business, so as to get it in more available form; these

were the cells lining the food pocket or future stomach. The labor being arduous, the metazoic consentience soon detailed certain other groups, or tracts of cells, to aid those of the stomach-sac ; and these afterwards developed variously as liver, pancreas, and other glands, great and small.

Still others took up the work of passing the liquefied pabulum to those other tracts or groups whose business was locomotion or intelligent direction of the whole union of cells ; and these in time developed as arteries, heart and veins.

But to be transformable to energy and carry on the physical business of the co-partnership, oxygen was needed ; the liquid food must be charged with oxygen ; and another cell group took up the business of admitting external air and infiltering oxygen. From this group has developed pulmonary tissue. But nerve, brain and muscle cells excrete waste products of the nature of poisonous refuse, to such deleterious extent that another cell group assumed the duty of extracting it from the circulation and washing it away ; and from this tract of cells we have the renal organs.

Still there was complaint that the food was not good enough, and another cell group, entering the sanguineous current, undertook the task of still further refining and vitalizing the plasma, now on its way to brain and muscle ; and from these laborers for the common weal have come the white and red blood-corpuscles.

It is at the price of all this auxiliary labor and only by virtue of it that the brain and muscle cells are nourished and are able to live so long and do so much in the way of locomotion and intelligence. Mind would be impossible on a poorer food for the brain cells.

And what is the lesson from this? Locomotion, intellect and a lifetime of a century have been attained by the metazoic cell from a food as good as that which now comes to them in the blood plasma. Yet that plasma still contains noxious particles, despite the efforts of the living organs which labor to refine and improve it. The inference is easy. Science must come to the aid of the organic apparatus and furnish a food clean, pure and easier of assimilation.

This brings us to the fundamental question, What is food? — a question which has been variously answered. Nor can it be answered at present. Food is that which renews the cells; and the cells absorb it from the plasma of the blood; but exactly what portion they absorb, or how much of what they absorb is necessary or best for this renewal, is not known. There is doubt whether the tissue cells are renewed as to their intimate structure or that nutrition, at bottom, adds ponderable matter to the cell, or is more than a replenishing of ions. We do not know that cell food is, or need be, anything more gross than ions or electrons. That is to say, the idea has begun to prevail, that nutrition as we now know it is an

immensely cumbersome and arduous process, attended by great strain and duress of the human organism, all of which science may obviate by presenting a food which will not require such hard physiological labor. The excretion of urea has been held to prove that there is structural waste and replenishment of cell substance. As nutrition is at present accomplished, this appears to be true, the result of a species of internal combustion from oxidation in the cell. Indeed, it is evident that the process of nutrition within each cell of the organism is, on a small scale, strictly analogous to what takes place in the stomach and intestinal tract of the larger multicellular organism ; that is, that there is intracellular ingestion, excretion, and assimilation of an esoteric plasma which renews the cell. That is what appears to occur ; but our question is, Need it occur ? Is it anything more or better than a laborious, destructive process which may be obviated altogether by inventing a more ethereal cell food ?

It has come to be doubted even whether a cell, after it has developed and grown to its full size in the adolescent organism, is ever normally destroyed or renewed so far as implying change of structure. The cell structure probably stands during the lifetime of the animal. The cell is no more wasted as to its *organella* than is the greater animal organism of which it is the vital unit. The physiological cell, indeed, is a minute organism, hav-

ing, in many tissues, a life term contemporary with that of the greater metazoic organism.

What, then, is the actual cell food? — and the cell food is equally the food of the metazoic organism.

Keeping in mind that much of what the cells take as food from the blood plasma is food in a gross condition, which necessitates intracellular conflagrations before it is reduced, smelted down, so to speak, and sublimated, fit for actual cell food, and at best leaving a portentous residue or slag that has to be gotten rid of, — keeping in mind this fact, I say, What is the real food of the cells? What is this last product of intracellular digestion which goes to cell maintenance.

Beyond doubt it is something refined, "ambrosial," ethereal, perhaps the ion itself, the electron. We know not as yet whether there is a decomposition of the atom of carbon, or of the other elements present in "protoplasm." Is the life of the cell dependent on the restoration of the component atoms by an intake of fresh ions, set free from the incoming food-stream? And if something of this nature is found to be true, is it not quite possible that a dynamic food which may be administered directly to the cells, without combustion, waste and residue is the desideratum of life on the earth?

Why are 98°+ Fahr. of organic heat requisite to human life? Clearly because of this food combustion rather than because the cell-of-life cannot live at a lower

temperature; life is possible below the freezing point; the cold-blooded organisms do not require so high a temperature. High temperature in mammals and birds appears to be a concomitant of nutrition rather than a biogenetic necessity to life itself. Not that animal intelligence would be heightened by a reversion to reptilian temperatures! But other methods of keeping the human organism warm could be found, methods less destructive to the component cells than by extra- and intracellular oxidation.

We are as yet, of course, at the first outer confines of this great question of cell food. But even now it begins to be evident how much depends on a better understanding of nutrition, and the great desirability of directing research in this direction, backed by the resources of the civilized world. Immortal life is the stake which science is playing for along this line of investigation. It is a true world-problem, one of those more than Herculean labors of the coming century which call for the united efforts of mankind.

At all this my scientific friends will smile and say, "Idle dreams, Utopian fancies! Mankind gives no token of such united action. Mad Mullahs, Mahdis, and War-lords bid fair to rant and run riot up and down the earth for centuries to come. Men have not sufficient knowledge

as yet to perceive the tremendous advantages of cooperation. Personal selfishness still outweighs the larger view. The inherent immorality of a short life prompts to snatch at personal pleasure and let the next generation take care of itself. It is all a part of this horrible immorality of certain death and cannot be ameliorated as long as human life is so perilously insecure and brief. With death but a few years ahead at best, human beings will work for those few years and continue indifferent to larger interests."

All of which is but too true. And yet there is always a measure of altruism in the human heart, a balance of philanthropic good-will and a strain of generous heroism, prompting individuals to deeds of self-sacrifice for the common weal.

It is to these saving traits in us that posterity, yet unborn, makes appeal. Personally, too, we would all of us be willing to do more than we do for the common good, and cooperate in mutual undertakings more than we do, but for the impracticability of such efforts, the difficulty of initiating united action, the inertia of existent social, political and economic methods. It is this inertia of olden forms, customs, race antipathies, creeds and national prejudices among the billion and a half of the earth's inhabitants which so baffles and withstands rational progress. All of which brings us to a practical question of what can first and best be done, under the circum-

stances, to unite the world's resources, combine human intelligence and render it effective to combat the causes of disease and death? What is the first practical step to this end? Can any plan be adopted by which intelligent persons of this generation can really get to work and bring their personal efforts to bear on the problem?

At first it appeared possible to the present writer that something could be done on a world-wide scale, and that the best method of beginning would be a world-league of science and of educated people generally, in every civilized country, irrespective of race or nation; for science is a common nation, a common country. And since there are many spoken languages and the Latin is the *lingua franca* of science, it seemed proper to call such a league, *Gens Scientiæ et Pacis*, The World-Nation of Science and Peace.

It seemed possible that scientific men and educated people, the world over, might thus organize to promote research on a grand scale, with greatly prolonged life in view. It was at once recognized that membership must not be construed as inimical to existent citizenship and allegiance to one's own country, but only as pledging members, individually, to use their best efforts to promote such researches, and in case of impending war, to avert it, by referring the matters in dispute to the already organized peace tribunals. Also in case of nationally selfish legislation, to defeat it in favor of a policy more inter-

nationally just; and in general, to promote a sentiment of universal good-will and confraternity, having clearly in view the union and concentration of the entire strength of mankind, to accelerate researches into the causes of disease, old age and death.

It appeared possible that such a world-league, having its headquarters in the United States and an extensive membership in every country of the globe, might come to exercise a controlling influence in mundane affairs. An international peace society we already have, which has opened the way to a peace tribunal; but the *Gens Scientiæ et Pacis* would be of wider scope, uniting persons of scientific attainments everywhere, and having a definite aim: the union of mankind for the application of all science and all the world's resources in the coming great struggle to reach the acme of Natural Salvation; to protect and rescue the human organism from its present hard fate.

It was not believed that the suggested league would make much progress with the alien races, save in cases of educated individuals. The burden of all progress and all achievement will long rest with the dominant race. The lower races, like the lower animals, will of necessity be coerced for the general good and their own good. The "rights of man" are sacred only when the man is disposed to make good use of them, and is intelligent enough to do so. The right to make the world better is a divine right, the natural prerogative and duty of superior knowl-

edge. An ignorant, ill-disposed race or nation, bent on selfish and aggressive courses, may properly be constrained to do right, even within their own ancestral territory. Men or races have no natural right to do wrong, even if never so sincere, never so self-holy.

With the Indo-European rests not only the responsibility to do right for the world, but the duty of seeing to it that others do right. This is, in very truth, "the white man's burden," the gravest of all responsibility.

In nearly all civilized countries there are now scientific associations, or what corresponds to this, which might on proper representation be united for promoting public enterprises of a scientific character. These societies and associations would serve as the national units of the proposed international *Gens*. Science, which is the mainspring of all present progress, is thus far deficient in methods of working on a world-wide scale, or even of acquainting, save by hearsay of the press, scientific men of one country with the aims and purposes of those in another. In many cases, it is not until published papers appear, that scientists in other lands gain an inkling of what cotemporary investigators are doing. Nothing like an economic division of labor in scientific research, or in the way of mutual aid, has as yet been attempted. This isolation, too, has bred a kind of jealousy and small secrecy concerning research, which obstructs rather than facilitates progress.

Perhaps nothing less than an engrossing common motive, like that of the achievement of greatly prolonged life, will suffice to unite and bind together the scattered scientists of different countries. That motive, at least, will prove the greatest incentive to united action. The sublimity of the object and the personal stake of each and all in the success of the endeavor would quite overshadow the baser sentiment of jealousy between investigators. The biological science of the twentieth century will be, indeed, working for life's sake. This interest will become universal and intense. Each fresh discovery, each new application of remedial skill, will be flashed from continent to continent and be hailed with an ever growing enthusiasm.

When once the idea has gone world-wide that science has good hopes not only of removing the causes of death, but of so facilitating and perfecting nutrition by improved food, that the struggle and stress of living will be lifted, then will be exhibited an ardent desire to live, such as the world has never known. No longer to pant for breath, or writhe beneath the torture of encroaching bacteria, will ennoble life and endow it with a new and passionate desire to live. We grow weary of living and resign ourselves to death only because of the pain and hopelessness of the struggle to breathe longer, — a struggle which will cease in vital calm and rest when research teaches us how nutrition takes place and what chemical substances are

the proper food of the cells, without the present hard labor of preparation.

No lengthy preamble or constitution for the proposed *gens* was thought necessary. Its strength was in its high purpose and intent. Indeed, the name itself was thought to be sufficient as constitution. And to all who are distinctly Christian, it was believed that the idea would appeal strongly as an efficient means of bringing the world in harmony with the central doctrine of the faith.

Two years' efforts to form such an association have brought out the practical side of the idea, and shown the difficulties which it has to encounter.

To minds normal and unperverted, Natural Salvation is the most natural thing in the world, the outcome of life which would be expected. But it is a curious commentary on the mental condition of people that the idea of being saved from death by natural means *often appears to them strange and unnatural!* Not unfrequently as something portentous and “wicked”! That higher life, which can only be attained by the loftiest culture of the human intellect, *is feared to be impious!* The fetters of old creeds are still firmly riveted. A few, indeed, and those of the best, recognize the truth; but a majority still cling to the fetish of ghost life, and incline to the belief that humanity will run through a cycle of evolution,

decline toward the lower animal orders and, in the end, perish from off the earth. They fail to see the significance which attaches to the steady growth of the human brain, a growth which separates and distinguishes mankind from all previous animal orders ; and they ignore or deprecate the grand fact that scientific knowledge, accumulating from generation to generation, is changing the entire course of lower nature in man. That lower course of nature is still their criterion for the future.

The idea of Natural Salvation as the result and outcome of the evolution of life on the earth is still too novel, too startling, to be accepted without a period of mental incubation. It is too subversive of old beliefs to be entertained without a struggle against it ; or at best, the new belief must have time to be born and grow up. And there must be further demonstration and a long balancing of the evidence. The incubus of indoctrination is still heavy ; nor will the effort to attain Natural Salvation begin in earnest, until the truth and the facts concerning the "soul " of man are understood and accepted ; perhaps not until children are taught the simple facts concerning the course and promise of life on the earth. The effect of two generations of such instruction would be decisive and marvelous. Little can be done till the brains of children are liberated and saved from the prevalent theological untruth as to supernaturalism. As fast as begotten and born the brain of successive generations is now handed

over to this bondage of the unnatural, these fantasies of the Orient. No child of Indo-European parentage is permitted to see life in the light of nature. The young cells of their tender brains are indoctrinated in the cradle. They never behold the universe in its true light, nor know what life really is or signifies, but walk through their span of years in a species of doctrinal trance. What genius among educators will rise to deliver unborn brain ! In very truth he will be another of the Christs of men.

And so slowly and at such sad disadvantage we must seek to instil the truth with patience against the inertia of old creeds ; and therein lies the reason and the apology for this little volume.

At the Darkest Hour

The Hour Before the Dawn

AT THE DARKEST HOUR.

THE HOUR BEFORE THE DAWN.

FROM many points of view the opening of the twentieth century is humanity's brightest hour; the brightest, the most hopeful since life first took root on the earth. Scientific discoveries are multiplying and open vistas of promise that even while they startle encourage us to hope great things. And other grander discoveries are, beyond doubt, at the threshold. There is a thrill of expectancy in the air of these opening years of the new century; a new faith that all which has preceded will soon be surpassed.

Inventions have prodigiously increased the powers of men to contend with nature and deal with material substances. Foodstuffs have been improved in quality and variety. Civil liberty to live has become better assured; transportation made easy, rapid and cheap. Throughout the length and breadth of the earth, the press, telegraph and telephone diffuse intelligence swiftly, and also enable public sentiment to find expression. The industries are organized and systemized as gigantic agencies for human

advancement. Wealth, too, is wonderfully increased and, despite all complaints and forebodings, was never before so evenly and justly distributed to all men. Never even in the fabled Golden Age have all men, irrespective of rank or birth, shared the advantages which wealth confers so equally. Not that such distribution is yet ideal or complete; far from it; but the present complaints, forebodings and *emeutes* are themselves the signs of a progress in equalization. In no former age and at no previous time has the so-called "poor man" enjoyed so generous a share of the world's wealth. The laborer at two dollars wages *per diem* reads the same newspaper, rides in the same car, attends the same amusements and eats much the same food as his wealthier fellow and, if he pleases, may live in a house equally sanitary, if not so large, and lie down to sleep on an equally soft spring mattress. The mere possession of a great fortune, indeed, now gives the possessor more care, but little advantage over his less opulent brother-man. Curiously enough wealth comes of itself to be the instrument for making all men equal.

When we consider the humble beginnings of organic life on the earth — developing as it has done from the primitive unicellular life — the spectacle presented by humanity at this epoch is one of reasonable promise. From the protozoa multicellular organisms have developed; and from these lower animal forms, man has arisen. It has been the slow work of millions of years; but it has been done

so surely and the progress has, on the whole, been so uniform and so well defined, that it appears highly improbable that this great evolutionary effort is to end in mortal man, incomplete as he is, with his many capacities for further progress undeveloped. Such stupendous balks in the order of nature occur only along the line of catastrophism ; a cosmic catastrophe involving the solar system might suddenly or slowly, end all things terrestrial. Otherwise a reasonable expectation obtains that humanity will make progress in the future as in the past.

What inclines many students of history to take hopeless views of man's future on earth is the contemplation of races, peoples and nations that have risen to a degree of greatness and power, and then declined. At short range observation the Seres and Hindus, for example, seem to furnish evidence that man can move through but a circumscribed arc of progress ; that the Cambodia and China of to-day inevitably succeed every upward saltus of mankind. Egypt, Chaldea, Persia, Greece, Rome, Baghdad, all present similar instances of rise and fall. If the student restricts his view to the history of any one nation in the past, he may be led to form a similarly hopeless opinion. The progress of humanity cannot be estimated by what takes place in any one quarter of the world, during any one century, or thousand years. Contrasted with what the world was in the days of Pericles and Augustus, who could have seen any hope for humanity in the year 700

A. D.? Yet the greater era of the Anglo-Saxon has succeeded, in due time.

In the large, mankind has developed by rhythmic advances and pauses. Collapse has followed each upward career; but always something grander succeeds. Ten thousand years is the briefest time period by which the progress and probabilities of the genus homo can be correctly measured. Ten thousand years, indeed, is but a yesterday in life's great curriculum on this planet.

Regarded in this larger light, and from the standpoint of progress in the physical sciences, art, and invention, humanity is at its brightest hour.

Grand, hopeful, and benign as is this progress, so prophetic of a mighty future for humanity, it is none the less tinged with an ever-deepening sadness for each and all of us, personally. A magnificent future is dawning, but we shall not see it. A few months, a few years more at most, and personally we must close our eyes in death, and drop back into the insentient void. In truth, it is this very awakening of the intellect, this latter-day vision of the future, which renders death so grievous, so inopportune.

It was not so with our ancestors. Life was a struggle too hard, too grim, to be greatly prized *per se*; the ills of life were numerous; they suffered from heat, cold, famine and the malignity of foes. The pleasures of life, too, were chiefly sensory and fleeting; hence their mental

attitude toward death was one of comparative indifference ; continued life offered too little to be very earnestly desired. This sentiment concerning death prevails largely to-day in the Orient and among savage tribes. Life is not wholly desirable, often the reverse, it holds so little of real enjoyment, so much of pain, fear and general misery.

The case of the well-to-do, well-lodged, and happily environed American of our own times is wholly different. Every day may be a pleasure, devoted to fresh achievements.

The youth of to-day, moreover, has need of vastly more time to realize his expanding ideals. Hitherto it was a hut, food and a wife that formed the sum of a young man's ambitions, the goal toward which his life developed : all obtained during twenty years of youthful effort. The aspirations of men have vastly enlarged. Fifty years scarcely suffices to realize the plans necessary to success in life. Formerly when the pleasures of life most sought were sensory, the realization was not far to seek, and when attained the vital *vis viva* slackened. But the pleasures most prized by the educated young man of our times require a longer initiative, three or four decades of patient study and sustained exertion. Life and the purposes of life are laid on wider lines for a loftier superstructure — the kind of living that outgrows the brief lifetime of our forebears.

Our ancestors, too, were solaced by pleasing illusions concerning a mythic life-after-death. The "soul of man" was believed to live on, disembodied and self-conscious, after the body died. The founders of religious cults made skilful use of this illusion and framed vast systems of ritual and dogma, in confident reliance on which millions lived and died, and even rushed to death, recklessly, battling for creed's sake. The second of the great religious systems of our era was successfully propagated and has been maintained by promises of paradise to those who fall fighting for the faith. The devout Christian regulates his life with reference to "heaven," and dies in the hope of going thither immediately after death,— and this although the Founder of Christianity apparently taught that the kingdom of God was the earth.

The point here made, however, is in effect that in past centuries, so far as human beings have aspired to longer life and desired continued existence, the aspiration has been satisfied by a partial faith in "soul" life. Such belief has sufficed considerably to assuage the pang of dying, and incidentally has led the devotee to despise corporeal life and disdain the earth as an abiding place. This, indeed, is the spirit and morale of Christian and Mohammedan life. Terrestrial life is subordinate and desirable only as a period of preparation and a point of departure for a paradise beyond the grave. This has been the consolation and the mental attitude of our fore-

fathers. We are not here discussing either the truth or the reasonableness of this faith. It is enough to say that the consensus of scientific knowledge precludes it and robs us of such consolation. If the doctrine of evolution and all that we know of life and living matter teach anything whatever, it is that the dissolution of the brain and spinal cord is the end of the conscious and subconscious life that subsisted there. Our efforts to preserve a semblance of faith to the contrary but embarrass and delay the growth of knowledge. The biologist of to-day faces the fact that death is the end of personal life. It is no longer the ladder to heaven, but the brink of unconsciousness.

Psychical research has accomplished nothing to alter or relieve this fact, nor is there the slightest reason to believe that it will or can do more than emphasize this "hard condition of our birth." We of this generation share all of primitive man's instinctive shrinking from death — the natural abhorrence of death which all life exhibits — and, in addition to this grief, we foresee the grand future of man on earth and perceive that for us, like the Hebrew lawgiver, there is nothing but this early glimpse from a mountain top afar. We live too early to enter the land of the great achievement. We shall not quite pass from death unto life. For us death will still be an irremediable evil.

But death is not an evil, many thoughtful persons will

rejoin, or, if an evil, it is, at least, a necessary one. What greater calamity could befall humanity, as human society and human civilization are at present established, than to have the passing generation not pass off, but remain on the crowded stage of human life? Even war and the slaughter of thousands is, by not a few political economists, regarded as a beneficial event for relieving the social congestion of overpopulated countries. If immortality were achieved, starvation, suicide on a national scale, infanticide, or the execution of aged persons would ensue from a necessity.

These are views which are fairly pertinent, although, properly administered, the natural resources of the earth are undoubtedly adequate to the sustenance of six billions of inhabitants, without crowding or poverty, in the place of the billion and a half who now dwell on it. This latter reflection does not meet the objection of overpopulation, however. Nor is it necessary to meet it, in the sense of providing field for a vast population, since Nature herself has already met it in her plan of vital evolution. The procreative instinct is intensified or diminished in ratio with the duress which human life encounters in the struggle for existence. With the hard-worked and short-lived, children multiply rapidly. Where all the conditions of life are hard and evil, procreation is active.

On the other hand, education, refinement, ease, leisure and the prospect of a long, happy lifetime redound not to

increase of population, but rather to diminution. So markedly, indeed, has this been found to be true, that the inference is a fair one, that were enlightened persons, men and women, freed from the fear of death, the cruder pleasures of procreation would be foregone, from choice, for greater and purer joys in a life of a higher type. We may, at least, reply confidently that those who are able to achieve greatly prolonged life for themselves will not overpopulate the earth.

More specifically death often is not an evil, but a blessing to the hopelessly diseased, infirm, and decrepit. Death may even be voluntarily and logically sought by the hopeless sufferer. There are grave doubts whether, if nothing better were to be hoped for in the future by humanity than life as the majority of our fellow-creatures hold it at present, — grave doubts whether unconsciousness were not better than the burden and pain of their lives.

These phases and negations but prove the converse of the question, however. The primary instinct of life is to live. Nature, *ab initio*, makes oath that *to be* is better than *not to be*; nor have all the consolatory sophistries of creeds ever really convinced a human being of normal intellect that he will live on personally conscious, remembering and seeing, after the death and dissolution of his body. Such "faith" may assist a little to mitigate the bitter pang of dying, but never fully reassures; the common sense still perceives the real situation, and cannot,

even in its ignorance and weakness, wholly believe the kindly meant promissory. At best we resign ourselves to lapse from life with a shudder and a sense of awful heart-break, and on the brink of the great darkness shrink back, and, feebly struggling to breathe again, turn our dim eyes to the beautiful light.

Man has literally fought his way upward ; he has battled for life and supremacy, first, with the fiercer orders of the carnivora, the cave-bear, the machairodus, then with his fellow-man for political and moral freedom. His last grim foe is death. "The last enemy that shall be destroyed is death." But as yet —

"Death reigns. Dust unto dust must go.
The nations wail of their dread foe.
The bitter waters of that Wormwood star
Which burns malign, from pole to pole,
Are to be drunk. Who may console
Their mortal woe ? Outwelling from afar
The grief of worlds bewails its dying pains,
A cosmic dirge, moaning it comes, Death reigns."

To all normal, healthy life, death is unquestionably an evil. Nature has nothing in common with those theorists who, making a virtue of temporal misfortune, seek to persuade man that death is a blessing. Scant must be their souls. Man has developed to live, not to die ; and time and space given, man is omnipotent.

How much of literature is a dirge, a cry of mortal

anguish for friends departed, for self departing from the joys of life! Dread of death is the spur which will drive men to the achievement of prolonged life.

Over all the past and the present hangs a pall, shot only by the bright intuitive hope that death is not a final law. With the Romans *Mors* was a goddess in black robes, with ravenous teeth, hovering on sable wings over the whole theater of life, darting hither and thither, snatching its prey. The imagery comports with the Roman character.

With the Greeks *Thanatos* was a god whose reign men mourn, whose mission is to nip the joy of life and blast the well-springs of hope. At his approach they shrank and cried, "Eheu! Eheu!" The conception is characteristic of beauty-loving Hellas. Her children ever shrank from that cold, dark realm where there was no sun. The despairing cry of Electra utters the Hellenic sentiment touching death. Burdened as was their faith with the tenets of Egypt, death was still to them the end of pleasure, the tomb of joy. The Greek poets sometimes symbolized Death and Sleep as brothers, twin boys, lying asleep in the arms of their mother, Night; and again Death as a winged boy with sad, white brow and inverted torch; at his feet a butterfly. These last were poetic fancies rather than popular conceptions.

The Hebraic portraiture of death was a solemn and august angel, flying forth from God, armed with a sharp

sword to slay the children of men who had sinned. Hence, the strange description of death in the *Apocalypse*.

To the Hindu death was personified by the soul of Yarma (Adam), the first man who died (according to their tradition), and who thus became the monarch of the dead.

Our old Norse ancestors thought of death as a cold, misty presence, rolling darkly on, like the whirlwind storms of their own northland, wintrily enveloping its victims and sweeping them away, enwrapped and lost from sight forever. With them death was associated with the bleak, elemental forces of the air, the sea, and the night, caught in the strife of which they so often perished.

In our times and in all time the vulgar imagery of death is a skeleton. Death makes a skeleton of man, hence man makes death a skeleton. In such grisly representation he foresees his fate. It was reserved for the grandeur-loving genius of Milton to draw death at once awful and truculent: —

“ The shape,
If shape it might be call'd that shape had none
Distinguishable in member, joint, or limb ;
Or substance might be call'd that shadow seem'd
For each seem'd either, — black it stood as night,
Fierce as ten furies, terrible as hell,
And shook a dreadful dart ; what seem'd his head
The likeness of a kingly crown had on.”

It is a curious fact that death, which is a nonentity, has always been typified by substantive imagery. In a word,

the utter absence of energy, or force, has been idealized as a monster of the most forceful character. Fancy has run away with fact. Death is *nothing* in itself, the synonym of nothingness, and has never been better defined than as the absence of life. Matter is inherently endowed with that which may become sentient. The human intellect, with this element of immortality within its grasp, shudders and sighs to cease. When the real situation shall become evident to human vision, a new era of mental activity will dawn. No longer vainly praying for miraculous redemption, man will arise to work out his own salvation, and labor for an immortality which will have no uncertain hold on his faith. The task is mighty; but a grand idea never yet perished for want of soldiers. Man, at least, has this record for his encouragement. Men would not be worthy of immortal life, would not be fit for it, if they cannot achieve it for themselves. Whenever in the past man has risen superior either to brute beasts or brute passions, it has been by his own unaided exertions. However piously he may have prayed and trusted, the fight has always been his own. Overmatched, the good and the bad have always been crushed alike. God is not on the hither side of matter. What is on its far side we know not. Yet Right, in the long run, appears to be a better soldier than Wrong. We may, if we please, fancy that God put this ingredient in matter and, having done that, retired to Olympus.

But during twelve hundred years the average of human life has not been raised more than twenty years, at most, what hope, then, of greatly prolonging life in ages to come?

The reply is that the outlook cannot be correctly estimated by this past slow gain on death. Through what unwritten ages did man wander over prehistoric continents, a wretched, fireless troglodyte, a feeder on acorns and berries, yet in one brief moment the first spark of fire was struck, — fire which made him the rich owner of all the metals, which opened a new realm of comfort, warmth, and food and spread the race over vast regions hitherto uninhabitable. In that single moment man rose to a higher plane of existence.

Within historic times, but four centuries ago, human progress was vastly accelerated by a single discovery, which was little more than a lucky accident. Up to the times of Gutenberg, what progress had been made for three thousand years in the art of book-making? Till then, books had been laboriously copied with stile and pen and so far as any one could then have foreseen, bade fair always to be thus tediously reproduced. A copy of the Scriptures cost from two to three thousand dollars, equivalent to six or nine thousands in this century; but a single decade saw the art of printing born.

Dogmatic unbelief may be as greatly mistaken as dogmatic faith. The times are ripe for great discoveries

touching life and its co-relative modes of energy. The epoch — and it will be the grandest of human epochs — when the protoplasmic molecule shall render up its secret to human scrutiny is near at hand. Man will then be no longer the abject serf of death, but a belligerent, contending for his freedom, with the prize of unlimited life before his eyes.

There are, it is true, degenerates who aver that all life is an evil. There are clubs that seek out, ponder, and discuss modes of euthanasia. They should be wished success. Such pessimism is an evil diathesis, a mental malformation of which the world would be well rid, by the shortest method. But we are speaking of normal men, not of posers, perverts, drug-bemused manikins and alcoholics.

For the normal man of science a new and sterner gospel is requisite. The awakening from dreams of paradise has come, and in very truth we have little enough to requite us. The devotee has much the more of solace, and many there are who will prefer the sacerdotal promise to the grim reality. It is so much easier to accept the gilded promissory of the established church than grapple with the real problems of life! Confessing one's sins is so much simpler than actual reformation! What wonder that the earth groans beneath a weight of mosques and cathedrals, or that four continents glisten with church vanes! Devotee and priest have this advantage: they

die with great hopes, and will never learn their mistake; whereas the man of science dies with the certainty that his course is run. Science, alas, has added a pang to death, for all her children.

It is, therefore, a sterner gospel into which we of this generation have to be baptized. We have partaken of the tree of knowledge. The pleasant illusions of man's early creeds have been brushed ruthlessly away. We face Nature's hard law with no fairy tale to disguise its inclemency. Immortal life will be achieved by the aid of applied science ; it is what the whole scheme of evolution moves forward to ; it is the dream of all the long-suffering ages of man ; it will be initiated on earth within three centuries, perhaps within two, so rapid is the growth of knowledge, so accelerated the march of discovery. But we who have to initiate the great effort will not look upon the dawn of the achievement, nor be among the first of the sons of men who rise superior to death.

We can but feel, therefore, that we live at humanity's darkest hour — the hour before the dawn. We live too late to be buoyed and comforted by the illusions of religion, too soon to reach the goal and snatch our lives from the grasp of death.

Have we the strength to work on, quite the same, and bravely round the curve for the sake of those more fortunate who shall come after us? Have we the devotion to face the inevitable, turn in our best work and die, uncom-

plainly? Shall we demonstrate the spirit, intent and real meaning of the doctrines of Jesus Christ, or see these grand doctrines lapse to a vacuous ritual?

A thousand centuries of life's hard struggle on the earth cry out to speak through us, and bid us win the promise of evolution. We are born to this post of honor and duty. Untold labor and pain have confided it to us.

Are we worthy? Or shall we quit the task, moulder, turn sensuous, skulk back to cover of illusion and cease to be progressive?

If stronger beings on other spheres of space are watching us from afar at this dark hour of our planet's evolution, may they infuse patience and courage into our hearts. We have need of them.